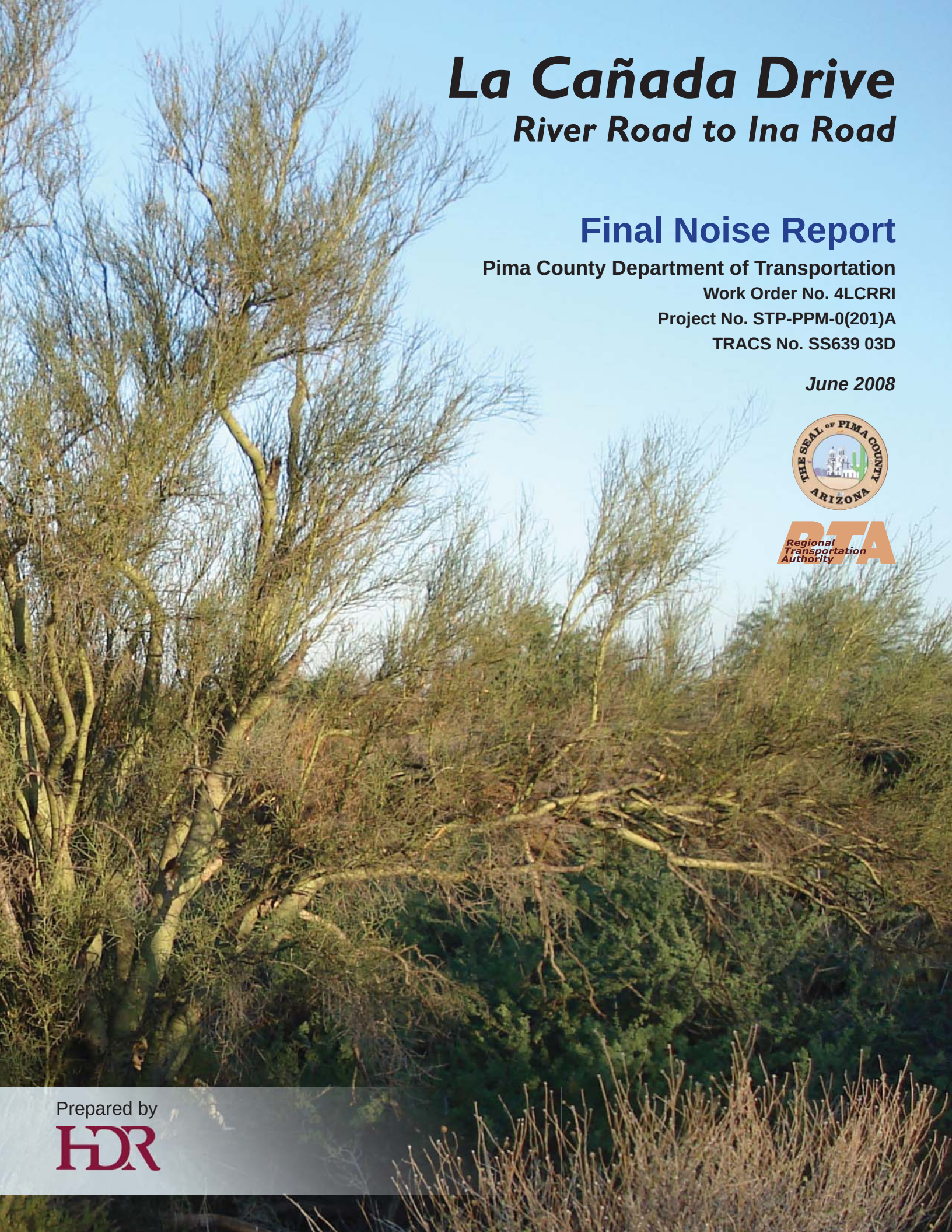

La Cañada Drive
River Road to Ina Road

Final Noise Report

Pima County Department of Transportation

Work Order No. 4LCRRI

Project No. STP-PPM-0(201)A

TRACS No. SS639 03D

June 2008

Prepared by

HDR

June 18, 2008

Mr. Rick Ellis, P.E.
Engineering Division Manager
Pima County Department of Transportation
Public Works Building
201 N. Stone Avenue, 3rd Floor
Tucson, AZ 85701

RE: Final Noise Report
La Cañada Drive, River Road to Ina Road
W.O. #4LCRRI
HDR Job No. 51587

Dear Mr. Ellis:

We are pleased to submit this *Final Noise Report* for the above-referenced project. This report was prepared by Catherine Bolm, Environmental Planner, and was reviewed by Christine Jacobs-Donoghue, Senior Environmental Planner. If you have any questions, please contact me at (520) 584-3629 or Scott Stapp at (520) 584-3670.

Sincerely,

HDR Engineering, Inc.

Michael H. Bertram, P.E.
Senior Project Manager

Attachments

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201 N. Stone Avenue
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HDR Project No. 51587

Table of Contents

1.0 Introduction 1
- 1.1 Project Location and Scope 1
- 1.2 Existing Roadway Conditions and Land Use 1
- 1.3 Planned Project Improvements 1

2.0 Methodology 4
- 2.1 TNM 2.5 Modeling 4
- 2.2 Noise Abatement Criteria 5
- 2.3 Level of Service Traffic and Noise Levels 7
- 2.4 Noise Analysis Overview 7
- 2.5 Other Possible Mitigation Strategies 8
- 2.6 Analysis Limitations 8

3.0 Existing Conditions 9
- 3.1 Existing Noise Environment 9
- 3.2 Roadway Geometry and Topography 9
- 3.3 Existing Noise Levels 9

4.0 Future Conditions 11
- 4.1 Future Noise Levels 11
- 4.2 Noise Analysis Results 11

5.0 Traffic Noise Considerations and Mitigation Alternatives 11

6.0 Construction Noise 12

7.0 Bibliography and References 14

8.0 Glossary 15

9.0 Abbreviations and Acronyms 17

List of Figures

Figure 1. Project location in state 2
Figure 2. Project vicinity 3

List of Tables

Table 1. Common outdoor and indoor noise levels 6
Table 2. Ambient noise levels compared with modeled noise levels 10
Table 3. Construction equipment noise 13

List of Appendices

Appendix A – Traffic Data

Appendix B – Monitoring Sites, Receiver Locations, and Potential Barrier Locations

Appendix C – Noise Analysis Summary

Appendix D – Noise Mitigation Evaluation

Appendix E – Traffic Noise Model (TNM 2.5) Output Files

1.0 Introduction

1.1 Project Location and Scope

This Pima County Department of Transportation (PCDOT) and Regional Transportation Authority project is being implemented in conjunction with the Federal Highway Administration (FHWA) and Arizona Department of Transportation (ADOT). It proposes to widen La Cañada Drive from River Road to Ina Road. The project is located in unincorporated Pima County. The Oro Valley town limits are located approximately 2.5 miles north of the northern project limit (Ina Road) and the Tucson city limits are located approximately 1.25 miles south of the southern project limit (River Road). Approximately 600 feet south of the southern project limit (River Road), La Cañada Drive's name changes to Flowing Wells Road. The project location is provided in Figure 1 and the project vicinity is provided in Figure 2.

Final engineering drawings and recent aerial photographs were used for this noise analysis. Traffic volumes for 2030 were obtained from the *Final Traffic Engineering Study for La Cañada Drive, River Road to Ina Road*, August 2007 (PCDOT 2007).

This noise analysis is based on design and traffic information available at the time of the analysis. Several assumptions were made to conduct the noise analysis. If the roadway design, traffic data, or other assumptions change, the results of this analysis and the mitigation considerations contained within this report would need to be reevaluated.

1.2 Existing Roadway Conditions and Land Use

La Cañada Drive is a major north-south arterial road between Oro Valley and Tucson. Roadway conditions in the Study Area consist of several four to five-lane arterial roadways and two lane collector streets.

Between River and Orange Grove roads, land use is primarily residential, with the exception of two schools, a church, and an office building. Lulu Walker Elementary School is located to the west of La Cañada Drive on Roller Coaster Road. La Cima Middle School is on La Cañada Drive between Sunset Road and Las Lomitas Road.

Between Orange Grove and Ina Road, land use is primarily residential, with the exception of an animal clinic and a church.

1.3 Planned Project Improvements

The project proposes to widen La Cañada Drive from River Road to Ina Road from a rural two-lane undivided roadway to an urban four-lane divided roadway with dedicated turn lanes at intersections.

Figure 1. Project location in state

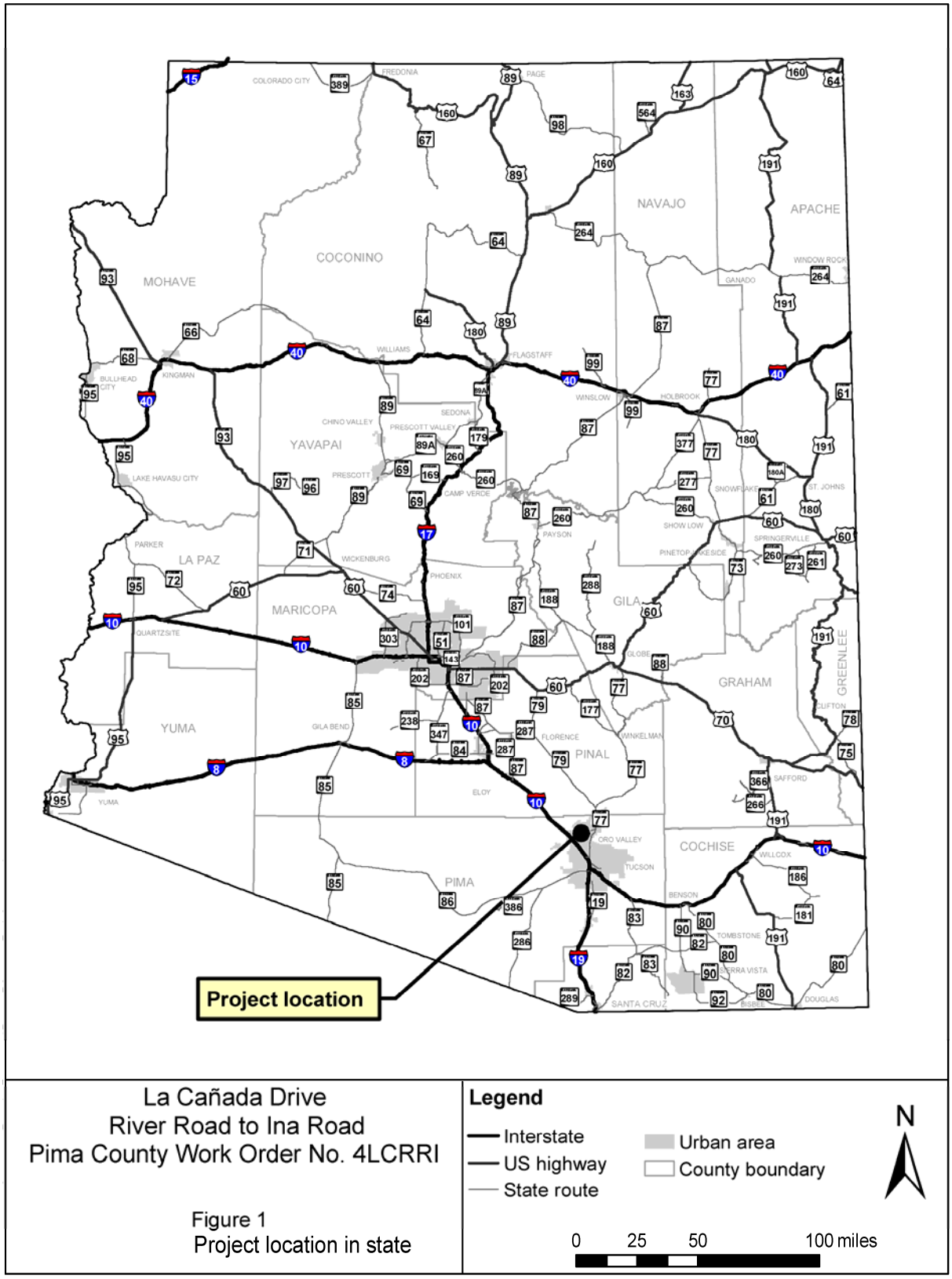
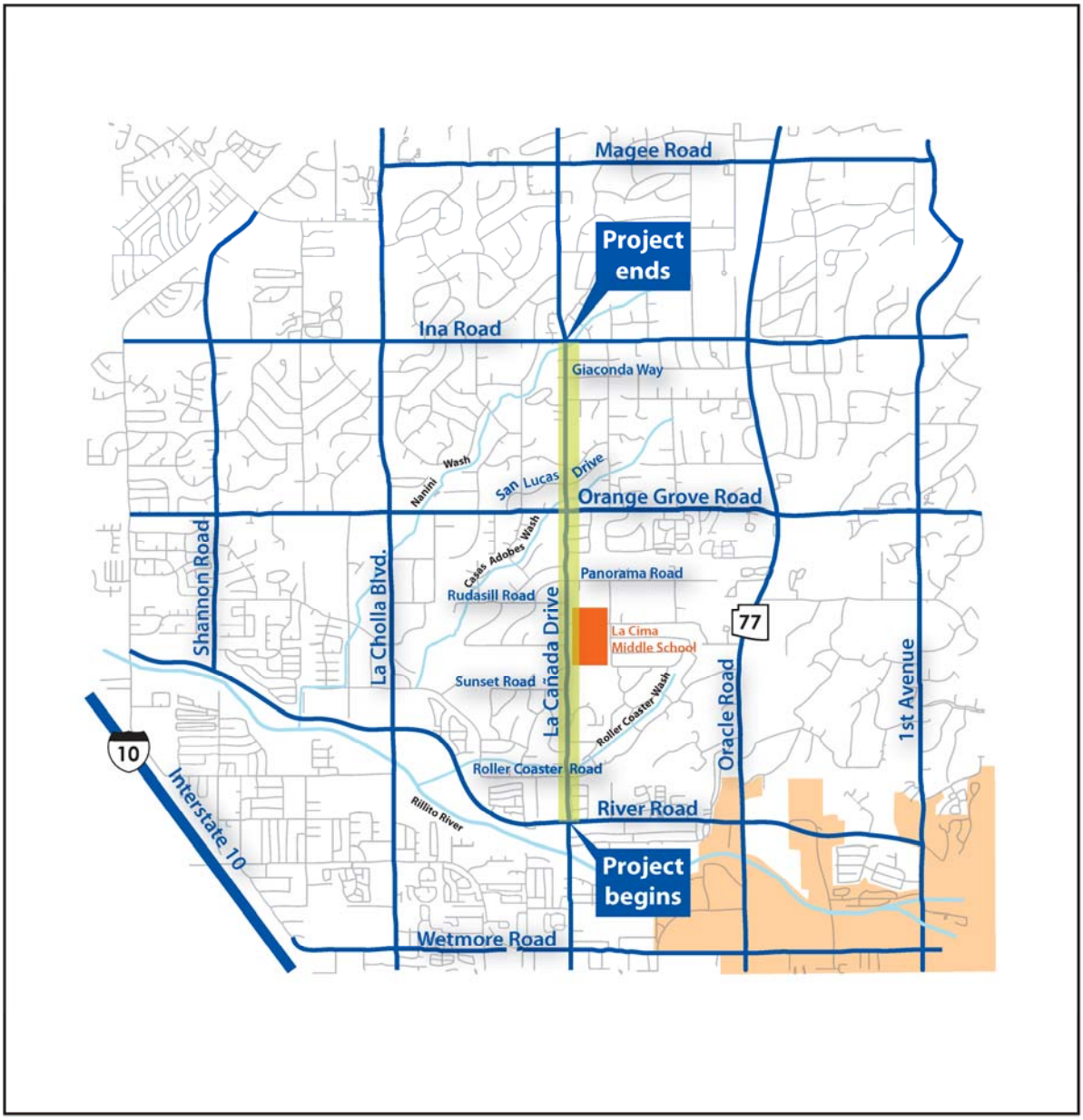


Figure 2. Project vicinity



Legend	
	Arterial street
	Interstate highway
	City of Tucson limits
	Project Area

N

0 .50 1.0 mile

La Cañada Drive: River Road to Ina Road
Pima County Work Order No. 4LCRRI

Project No.	TRACS No.
STP-PPM-0(201)A	SS639 03D

2.0 Methodology

A new or expanded roadway may introduce or increase traffic-generated noise in the surrounding area. For this study, the methods for determining the potential future noise levels and potential methods of mitigation included using the Federal Highway Administration (FHWA) Traffic Noise Model Version 2.5 (TNM 2.5) and following certain noise abatement criteria established by the governing agency, PCDOT.

To assess the potential change in noise levels, the existing noise environment was evaluated. Representative sites within the Study Area were chosen and the existing noise levels were recorded at the sites. The noise levels measured at these sites are the ambient noise levels. Roadway geometry and topography, traffic volumes, existing barriers, land features, and the representative sites were entered into TNM 2.5 to replicate the conditions under which the noise level measurements were taken. Noise levels were calculated and compared with the ambient noise levels. This process examines the accuracy of the traffic noise model in performing noise level calculations for this project. Discrepancies in the model's calculations are addressed prior to using it for predicting future noise levels.

Three conditions were modeled using TNM 2.5. The models estimated the peak-hour traffic noise levels for:

- existing condition (2007)
- projected condition without noise mitigation (2030)
- projected condition with noise mitigation (2030)

The 2030 projected conditions were evaluated with the Pima County Noise Abatement Criteria to determine if noise mitigation was warranted.

2.1 TNM 2.5 Modeling

The TNM 2.5 model translated the roadways in the Study Area into a series of endpoints on a three-dimensional X, Y, and Z coordinate system. This computer model was developed to comply with FHWA noise regulations and is considered the current standard for roadway noise analyses.

The TNM model requires input data regarding the geometry of the roadways in the Study Area, traffic volumes, vehicle mix, and vehicle speeds. The proposed roadway and the surrounding arterial streets were defined by a series of roadway segment endpoints. Existing barriers, including residential privacy walls, were included in the model. Receivers were identified as single points and assigned an elevation of 5 feet above the ground to simulate the average height of human hearing. Traffic volumes and speeds are used by the model to determine the noise produced by vehicles traveling on the roadway.

The vehicles were classified as automobiles (four wheels), medium trucks (six wheels), and heavy trucks (eight or more wheels). Each of these vehicles generates noise from a different height above the roadway, called the source height.

TNM 2.5 uses the above-described information to calculate the noise contribution from each roadway segment to each receiver and then determine the cumulative effect of all roadway

noise sources for each receiver. Validation studies conducted at the Volpe National Transportation Systems Center, a facility of the United States Department of Transportation (USDOT) Research and Innovative Technology Administration, show that the TNM 2.5 model typically predicts noise levels within 3 dBA of measured values. In general, the level of accuracy is higher for receivers located near the roadway (within a few hundred feet) than for more distant receivers, largely because of wind and temperature gradients.

While the TNM 2.5 model has been calibrated and tested against actual noise measurements for several years, it should be noted that it is still a noise prediction model. Based on the assumptions stated in this report, it "predicts" noise levels along the proposed roadway for 2030, the project design year. Actual noise levels at that time may differ because of many factors, including design changes and variability in traffic volumes, vehicle mix, and vehicle speeds.

2.2 Noise Abatement Criteria

Pima County Code, Chapter 10.56, Ordinance No. 1992-69 (7.1)(c), states:

> Noise abatement shall be incorporated into the project design to protect inhabited residential or other sensitive land uses from roadway traffic noise. Noise abatement measures shall be considered for these land uses when existing or design year projections of exterior traffic noise measurements exceed an hourly A-weighted sound level of sixty-seven dBA or when there is an increase in noise measurements of fifteen dBA or greater. The preferred method of noise abatement shall be the construction of noise barrier walls. Other methods such as rubberized asphalt, berms, and/or landscaping may be utilized if the cost to Pima County does not exceed the cost of noise barrier walls.

The Pima County Department of Transportation Procedure Number 03-5, entitled "Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects," dated December 1, 2003, was developed to provide guidance for the development of noise mitigation for Pima County's major roadway projects. It contains procedures for traffic noise abatement, noise analysis methodology, and requirements for noise reports. The procedure is most commonly called the Pima County Noise Abatement Procedure (PC NAP). Numerous existing state and county transportation agency policies were evaluated during the development of PC NAP and analyzed to determine the appropriate criteria to use in Pima County.

Effective April 7, 2008, the Pima County "Revision of Traffic Noise Analysis and Mitigation Guidance for Major Road Projects" was implemented to address changes in cost for sound mitigation. This report reflects the updated mitigation costs per benefited receiver and barrier construction cost per square foot.

According to PC NAP, noise-sensitive properties are individual housing units, multifamily or single family. They may also include facilities such as picnic areas, recreation areas, playgrounds, active sports areas, parks, schools, churches, libraries, hospitals, places of worship, and cemeteries. Noise abatement should be considered if noise levels reach 66 dBA or higher. Additionally, mitigation measures will be considered for noise-sensitive properties if predicted traffic noise levels substantially exceed existing levels. "Substantially exceed" is defined as an increase of 15 dBA.

Table 1 presents the noise levels, in A-weighted decibels, produced by several common indoor and outdoor activities and noise sources.

Table 1. Common outdoor and indoor noise levels

Common outdoor noise levels	Noise level (dBA[a])	Common indoor noise levels
	110	rock band
jet flyover at 1,200 feet	100	
gas lawn mower at 3 feet, diesel truck at 50 feet	90	food blender at 3 feet
noisy urban daytime	80	garbage disposal at 3 feet
gas lawn mower at 100 feet	70	shouting at 3 feet, vacuum cleaner at 10 feet
commercial area	60	normal speech at 3 feet
quiet urban daytime	50	large business office, dishwasher next door
quiet urban nighttime	40	small theatre, large conference room (background)
quiet suburban nighttime	30	library
quiet rural nighttime	20	concert hall (background)
	10	broadcast and recording studio
	0	threshold of hearing

Source: American Association of State Highway and Transportation Officials, 1993
[a] A-weighted decibels

As part of the noise abatement procedure described in the PC NAP, a credit of 3 dBA is applied for the use of rubberized asphalt. However, this project is receiving federal funds, and FHWA does not currently allow the credit of 3 dBA for rubberized asphalt as part of the noise abatement criteria. Therefore, the credit will not be used as part of the noise evaluation for this project.

Noise abatement measures must be reasonable, feasible, and desired by the affected individuals. Feasibility considers whether it is structurally and acoustically possible to provide the noise abatement, i.e., whether the topography allows a barrier to be built or whether a substantial noise reduction will be achieved. An analysis of feasibility also takes into account drainage issues, safety considerations, maintenance requirements, and whether or not other noise sources are present in the area. Reasonability means that PCDOT believes mitigation measures are prudent, based on consideration of the following conditions:

- The cost of the noise abatement shall not exceed $35,000 per benefited receiver, at $25 per square foot of constructed barrier.
- The noise barrier will benefit more than one sensitive property.
- The noise barrier will provide a 5-dBA noise reduction without being more than 10 feet high.

Commercial properties are not considered for noise abatement unless they include a sensitive receiver, as defined above (for example, a shopping center that includes a preschool).

Although noise barriers may be reasonable and feasible, a majority of the owners for the benefited properties must approve of the barrier for it to be constructed. Signatures from fifty percent plus one of the impacted property owners indicating a desire for the barrier is considered a majority.

2.3 Level of Service Traffic and Noise Levels

Traffic engineers describe the flow of traffic with a series of conditions called levels of service (LOS). LOS A describes free-flowing traffic that is able to travel at or above the posted speed limit with little or no difficulty in changing lanes. The conditions become more congested as the LOS progresses through the alphabet to LOS F, which represents stop-and-go traffic. From a noise perspective, the LOS C condition usually represents the worst hourly traffic noise impacts because traffic speeds are at or near the posted speed limit and lane capacity is high. Although more vehicles may be accommodated when LOS D is achieved, the lower speeds drastically reduce tire noise, a major source of traffic noise.

Traffic volumes for 2030 were obtained from the *Final Traffic Engineering Study for La Cañada Drive, River Road to Ina Road*, August 2007 (Appendix A). Peak-hour traffic data were used for the noise analysis. These data approximate LOS C conditions as they would occur along the improved La Cañada Drive.

2.4 Noise Analysis Overview

Aerial photographs and field reconnaissance were used to determine the approximate locations and land use activities of potential sensitive receivers near the roadway. Field measurements were used to determine the existing noise levels throughout the Study Area, as described in Section 3.0, *Existing Conditions*. The TNM 2.5 model was used to predict the noise levels that would occur with the proposed improvements to La Cañada Drive. Standard English units of measurement were used for this study.

As noted earlier, traffic-generated noise levels are affected by traffic volumes, traffic speeds, and traffic mix (the percentage of cars, medium trucks, heavy trucks, buses, and motorcycles). These variables were used in the TNM 2.5 model to predict future noise levels at the sensitive receiver locations. Traffic volumes and speeds used in the modeling for this project represent LOS C.

Unmitigated noise levels for the 2030 traffic and roadway conditions were determined and compared with the appropriate noise abatement criterion to determine whether traffic noise mitigation should be considered. Generally, the mitigation considerations consist of noise barriers in the right-of-way (R/W). Although other mitigation considerations are possible, noise barriers are considered the most cost-effective and accepted technique when they are warranted. These barriers may consist of earth berms or concrete/masonry walls, or combinations of the two barrier types.

2.5 Other Possible Mitigation Strategies

Noise mitigation strategies typically consist of placing a noise barrier, such as a concrete or masonry wall or an earth berm, along the roadway or at the R/W line of a transportation corridor. Noise barriers are usually the most feasible and cost-effective mitigation strategy for addressing roadway noise.

A number of mitigation strategies are available that could be considered for use instead of, or in addition to, noise barriers. These involve elements of the roadway alignment, design features, and restrictions on the use of roadway.

Depressing the Roadway

Throughout the Study Area, the profile of La Cañada Drive is similar to the natural grade of the surrounding land. Depressing the profile of a roadway below grade would allow the sloped embankments to act as noise barriers, thereby reducing the noise impacts on adjacent properties (FHWA 1980). Placement of noise barriers at the top edge of the side slope or at the R/W line would further reduce noise at nearby properties. This strategy would also reduce the visual impacts associated with tall noise walls on elevated roadways (FHWA 1994). A major disadvantage of this strategy, however, would be the substantially increased construction cost to depress the roadway.

Rubberized Asphalt Pavement Surface

ADOT recently embarked on a multiyear pilot program, in cooperation with FHWA, to overlay the roadway surfaces of the metropolitan Phoenix freeway system with a rubberized asphalt pavement surface. Rubberized asphalt pavement has been shown to reduce noise impacts by as much as 5 dBA, and sometimes greater, at adjacent properties when compared with standard concrete pavement (JHK and Associates 1996). Pima County uses rubberized asphalt on all roadway projects and allows a noise analysis credit of 3 dBA to account for the noise reduction properties of the pavement. Rubberized asphalt will be used on the La Cañada Drive project; however, for reasons stated in Section 2.2, *Noise Abatement Criteria*, the credit could not be used for this noise analysis.

Truck Traffic Restrictions or Reduced Posted Speed Limit

Discussions about reducing traffic noise commonly focus on restricting truck traffic entirely or during certain hours of the day and reducing the posted speed limit. In theory, both strategies would reduce the noise levels at adjacent properties because trucks produce more noise than automobiles and because higher speeds generate more noise than lower speeds (FHWA 1976). Neither of these strategies, however, would be consistent with the design parameters for this project and, therefore, would not be feasible for La Cañada Drive.

2.6 Analysis Limitations

This noise analysis is based on design and traffic information available at the time of the analysis. Several assumptions were made to conduct the noise analysis. If the roadway design, traffic volumes, or other assumptions change, the results of this analysis and the mitigation considerations contained in this report would need to be reevaluated.

3.0 Existing Conditions

3.1 Existing Noise Environment

Sensitive noise properties within the Study Area were mostly single-family residential properties on large lots. The Study Area contains some multifamily residential areas in the southern portion. The church and La Cima Middle School are also considered to be sensitive noise properties along La Cañada Drive. .

Existing walls and fences within the Study Area were examined to determine whether they would affect sound transmission. Eight walls within the Study Area were 6-inch-thick block walls. They were included in the model. An existing 6-foot-high berm between the roadway and several residences was included in the model.

Many of the residential properties have direct access onto La Cañada Drive, which will be maintained with the proposed roadway improvements. Direct-access driveways reduce the effectiveness of noise mitigation with barriers because gaps in noise barriers allow noise to travel beyond the barrier.

3.2 Roadway Geometry and Topography

The horizontal alignment for La Cañada Drive consists of straight roadway segments. The vertical alignment follows the existing terrain with relatively mild grades.
Immediately north of River Road, La Cañada Drive is five lanes across, with two through lanes in each direction and a continuous left-turn lane. Approximately 260 feet north of Roller Coaster Road, the road narrows to three lanes, with one lane in each direction and a continuous left-turn lane.

At the southern leg of Las Lomitas Road, La Cañada Drive again narrows, this time to a two-lane section. It continues as two lanes for approximately 460 feet northward. At Calle Kino/Panorama Road, the roadway widens to three lanes, with one through lane in each direction and a continuous left-turn lane. The roadway widens again, near Via Tierra, to five lanes and continues through the Orange Grove Road signalized intersection. Approximately 350 feet north of the intersection, the roadway tapers from three lanes to two lanes. At Giaconda Way, the roadway again widens to four lanes as it crosses the Ina Road signalized intersection.

The terrain within the Study Area is gently rolling, with elevations ranging from 2,280 to 2,440 feet above mean sea level, increasing from south to north.

3.3 Existing Noise Levels

Field readings were taken at four monitoring sites within the Study Area to determine the existing noise levels (Table 2). The monitoring sites are described below and are shown in Appendix B, *Monitoring Sites, Receiver Locations, and Potential Barrier Locations*.
The existing noise levels were recorded at the monitoring sites with a Larson Davis Model 820 Type 1 integrating sound level meter. The sound level meter was placed approximately 5 feet above the ground at the monitoring sites. Three 10-minute-long sound level recordings were taken at each site.

The readings were taken during the peak-hour traffic flow on January 17, 2007, from 7 to 8:30 a.m. and from 4 to 5:30 p.m., and on January 24, 2007, from 7 to 8:30 a.m. and from 4 to 5:30 p.m.

The weather conditions during the January 17, 2007, readings were clear skies with temperatures at 31 degrees Fahrenheit in the morning and 66 degrees Fahrenheit in the evening. The relative humidity in the morning was 59%, with a breeze coming from the north, averaging 1.5 mph. The evening had 15% relative humidity, with a breeze coming from the south, averaging 1.3 mph.

The weather conditions during the January 24, 2007, readings were clear skies with temperatures at 39 degrees Fahrenheit in the morning and 62–65 degrees Fahrenheit in the evening. The relative humidity in the morning was 54%, with a breeze coming from the north ranging from 4.5 mph to 6.7 mph. In the evening, the relative humidity was 20%, with a breeze coming from the southeast ranging from 2 mph to 4.6 mph.

The field reading locations were also modeled in TNM 2.5 to evaluate the accuracy of TNM 2.5 to predict noise levels for the Study Area. The field readings were compared with predicted sound levels from the modeled conditions. This comparison was made to determine if the model was accurately predicting site conditions.

Table 2. Ambient noise levels compared with modeled noise levels

Location	Ambient noise level (average dBA)	Modeled noise level (dBA)
1. 5230 N. La Cañada Drive – approximately 32 feet from edge of pavement	71	68
2. 5600 N. La Cañada Drive, La Cima Middle School – approximately 35 feet from edge of pavement and 15 feet behind a block wall	66	64
3. 6431 N. La Cañada Drive – approximately 30 feet from edge of pavement and 15 feet in front of block wall	72	69
4. 6901 N. La Cañada Drive, Tucson Church International – approximately 50 feet from edge of pavement and 28 feet in front of block wall	71	68

The existing monitored peak-hour noise levels ranged from 66 dBA to 72 dBA at the monitored locations, which ranged between 30 feet to 50 feet from the edge of pavement of La Cañada Drive. The locations were at or near the R/W line for La Cañada Drive. The dominant noise source at each of the monitoring sites was traffic on La Cañada Drive.

Predicted existing peak-hour noise levels ranged from 64 dBA to 69 dBA at the monitored locations. TNM 2.5 calculated noise levels 2 to 3 dBA less than the measured levels. This discrepancy is largely due to the condition of the roadway at the monitoring sites. As can be detected in the aerial photographs in Appendix B, the existing pavement features severe alligator cracking. This degraded pavement condition will cause an increase in the ambient

noise levels produced by tire/pavement contact. No adjustments were made to the model to represent the noise produced by the degraded roadway because the new roadway will be re-paved with rubberized asphalt concrete, eliminating the existing alligator cracking and associated noise. Based on the results, TNM 2.5 was considered calibrated to accurately predict noise levels for this project.

In addition to the ambient noise level monitoring at select locations, 114 sensitive receiver locations were identified within the Study Area. Predicted existing noise levels were modeled at each of these receiver locations. Predicted existing peak-hour noise levels along La Cañada Drive ranged from 53 dBA to 65 dBA.

4.0 Future Conditions

4.1 Future Noise Levels

Noise levels were evaluated for 114 sensitive receiver locations within the Study Area. The receivers were generally located within a few hundred feet of the proposed La Cañada Drive centerline. The receivers were evaluated for the future build condition, with the planned improvements and the future (2030) peak-hour traffic volumes.

4.2 Noise Analysis Results

The 114 sensitive receivers were evaluated for traffic noise levels resulting from 2030 peak-hour traffic conditions. The results of the noise analyses are included in the *Noise Analysis Summary* (Appendix C). The first column in Appendix C lists an arbitrarily assigned number used to identify the receiver. Identification numbers begin at the south end of the project and progress numerically toward the north end. The second column lists the distance and direction from the future roadway centerline to the sensitive receiver. The third column lists the address of the property the receiver represents. The fourth column provides the existing condition modeled noise levels, in dBA L_{Aeq1h}, at the sensitive receivers. The fifth column provides unmitigated noise levels for the future build condition, using the proposed improvements and the 2030 peak-hour traffic volumes. The sixth column displays the mitigated noise levels, assuming the potential noise barriers were to be constructed. The seventh column provides a determination of whether mitigation should be considered at each location, based on the PC NAP.

Predicted future peak-hour noise levels along La Cañada Drive would range from 56 dBA to 71 dBA. Of the 114 sensitive receiver locations, 61 would exceed the PC NAP mitigation criterion. These 61 receivers would be eligible for noise abatement consideration, as discussed in the next section.

5.0 Traffic Noise Considerations and Mitigation Alternatives

Several mitigation measures can be considered by Pima County to avoid, reduce, or otherwise mitigate environmental impacts associated with the proposed project. The discussion of these measures in this report does not obligate Pima County to implement them. Pima County may choose to modify, delete, or add measures to mitigate impacts.

Predicted future noise levels would exceed the PC NAP mitigation criterion for noise-sensitive properties at 61 of the114 sensitive receiver locations. Noise mitigation measures were evaluated for these receivers. Noise walls and earth berms are the most common types of noise mitigation measures used along roadways. These measures are discussed below and summarized in Appendix D, *Noise Mitigation Evaluation*. Other noise mitigation strategies that could be applied in addition to, or instead of, standard noise walls or earth berms are discussed in Section 2.5, *Other Possible Mitigation Strategies*.

According to PC NAP objectives, noise mitigation should achieve a reduction of at least 5 dBA to be considered reasonable. Barrier heights must not exceed 10 feet in height. The number of benefited receivers per wall must be at least two.

Thirty-six barriers would be needed to reduce noise levels in accordance with the PC NAP along the improved La Cañada Drive. The barriers would range in height from 6 feet to 10 feet and would reduce noise levels at the affected sensitive receivers to between 61 dBA and 67 dBA.

The noise levels at 17 of the receivers could not be reduced in full accordance with the PC NAP requirements because the effectiveness of the barrier was limited by the 10-foot barrier height limitation or gaps in the barrier to maintain driveway access to adjacent properties. These receivers would achieve noise reductions of 1 dBA to 4 dBA, less than the requirement of at least 5 dBA. The placement of some of these barriers provided other receivers with the minimum 5-dBA reduction. For these barriers, the cost per benefited receiver was calculated using only the number of receivers receiving the minimum 5-dBA reduction, in accordance with the PC NAP.

Of the 36 barriers evaluated along La Cañada Drive, six were able to reduce the sound levels of the benefited receiver to meet the minimum 5-dBA reduction. However, only six barriers met the PC NAP parameters for noise reduction, cost per benefited receiver, and number of benefited receivers per wall. The six barriers would amount to approximately 17,155 square feet in area. Following the standard cost of $25 per square foot, as recommended by the PC NAP, the cost of the noise mitigation along La Cañada Drive would be approximately $429,000. Please refer to Appendix D for more details.

Two of the 114 sensitive receiver locations are at properties anticipated to be taken for the future R/W. These properties are 5335 N. La Cañada Drive (receiver 17B) and 5365 N. La Cañada Drive (receiver 20). The predicted noise levels at these locations exceeded the PC NAP, so they were included in the mitigation. However, in anticipation of the removal of the structures for the proposed project, the noise levels at the potentially exposed properties were also analyzed. With no obstructions, the predicted noise levels at those properties did not meet PC NAP criteria for mitigation. The results are included in Appendix E.

6.0 Construction Noise

Construction of any part of the proposed improvements may cause temporary noise impacts. The quantification of such impacts is difficult without data on this project's construction schedule and equipment use. Therefore, certain assumptions were made to predict the approximate noise level at the R/W line. These predictions are based on the loudest equipment expected to be used during each construction stage of a typical roadway project. Data on

construction equipment noise are available from the USDOT's *Highway Construction Noise: Measurement, Prediction and Mitigation* (1977).

An analysis was conducted during a freeway construction project in Arizona that assessed the collective impact of construction noise. The noise levels were calculated at the R/W line. The distance between the R/W line and the construction activity was estimated based on the type of work being performed.

The results of the preliminary estimates, shown in Table 3, indicate that sensitive receivers could be affected by construction noise if the receivers are immediately adjacent to the R/W. The highest noise levels would occur during the grading/earthwork phase.

Table 3. Construction equipment noise

Phase	Equipment	Equipment L_{max}[a]	Number of feet to right-of-way	L_{max} at right-of-way
Site clearing	Dozer	84	50	88
	Backhoe	85	50	
Grading/earthwork	Scraper	92	75	93
	Grader	91	75	
Foundation	Backhoe	85	100	85
	Loader	84	100	
Base preparation	Compressor	85	100	85
	Dozer	84	100	

[a] maximum instantaneous sound level in decibels

Impacts from construction noise will be minimized by restricting all construction related activities to be conducted between dawn and dusk.

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———. 1995. *Highway Traffic Noise Analysis and Abatement, Policy and Guidance*.

8.0 Glossary

ambient noise level: The noise level existing in an area before the introduction of a proposed roadway improvement project. This quantity is measured in dBA and expressed as L_{eq} ambient noise levels.

at-grade roadway: A roadway that is level with the immediate surrounding terrain.

automobiles: All vehicles with two axles and four wheels, designed primarily for passenger transportation of cargo (light trucks). Generally, the gross vehicle weight is less than 10,000 pounds.

barrier: A solid wall or earth berm that breaks the line-of-sight between the roadway and noise receiver location, reducing the noise level at the receiver.

decibel (dB): A logarithmic unit that indicates the amount of sound energy.

decibel, A-weighted (dBA): The A-weighted decibel scale approximates the sensitivity of the human ear. The approximate threshold of hearing is 0 dBA, while the approximate threshold of pain is 140 dBA. Most suburban areas have daytime noise levels ranging from 50 to 70 dBA.

depressed roadway: A roadway that is constructed below the immediate surrounding terrain.

design year: The future year used to determine the probable traffic volume for which a highway is designed.

elevated roadway: A roadway that is constructed above the immediate surrounding terrain, either on an embankment or a structure.

existing noise levels: The noise resulting from the natural and mechanical sources and human activity usually present in a particular area.

heavy trucks: All vehicles having three or more axles and eight or more wheels that are designed for cargo transportation. Generally, the gross vehicle weight is greater than 26,400 pounds.

L_{Aeq1h}: The L_{eq} for one hour.

L_{eq}: The equivalent steady-state, A-weighted sound level which, in a stated period of time, would contain the same acoustical energy as the time-varying sound levels during the same period.

level of service (LOS): The operating performance of a freeway or intersection. Level of service is a qualitative description of operation based on the degree of delay and maneuverability.

light trucks: All vehicles with two axles and four wheels designed primarily for transportation of passengers and cargo. Generally, the gross vehicle weight is equal to or less than 10,000 pounds.

medium trucks: All vehicles having two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 10,000 pounds but less than 26,400 pounds.

noise level reduction: The process of removing noise from an observer by the application of noise mitigation.

peak hour: The single morning or evening hour when the maximum traffic volume occurs.

receiver: The location at which noise levels are measured, modeled and analyzed. Receivers of interest are typically residences, schools, parks or other noise-sensitive properties.

right-of-way (R/W): Publicly owned land used or intended to be used for transportation and other purposes.

rubberized asphalt: This material consists of regular asphalt paving mixed with ground-up, used tires. Rubberized asphalt is generally smoother and quieter, helping to reduce tire noise.

sound level (noise level): Weighted sound level measured with a sound-level meter having metering characteristics and a frequency weighting of A, B, or C, as specified in the sound-level meter standard.

speed: The rate of movement of vehicular traffic, in miles per hour (mph).

traffic noise impacts: Impacts that occur when the predicted traffic noise equals or exceeds the noise abatement criteria (NAC) levels.

9.0 Abbreviations and Acronyms

ADOT	Arizona Department of Transportation
dBA	A-weighted decibel
FHWA	Federal Highway Administration
LOS	level of service
PAG	Pima Association of Governments
PCDOT	Pima County Department of Transportation
PC NAP	Pima County Noise Abatement Procedure
R/W	right-of-way
TNM 2.5	Traffic Noise Model Version 2.5
USDOT	United States Department of Transportation

Appendix A

Traffic Data

Traffic Data

Existing and projected traffic volumes were obtained from the *Final Traffic Engineering Study for La Cañada Drive, River Road to Ina Road*, August 2007. Existing directional 24-hour traffic volumes were collected on Wednesday, February 14, 2007, at two mid-point locations within the Study Area.

- La Cañada Drive, midway between River Road and Orange Grove Road
- La Cañada Drive, midway between Orange Grove Road and Ina Road

Existing peak-hour traffic volumes are as follows:

Table A-1. 2007 existing peak-hour traffic volumes

Location	Northbound vehicles	Southbound vehicles
Between River Road and Orange Grove Road	884	884
Between Orange Grove Road and Ina Road	872	872

Source: Kimley-Horn and Associates, Inc, *Final Traffic Engineering Study for La Cañada Drive, River Road to Ina Road*, August 2007

The future conditions were calculated based on traffic projections from the Pima Association of Governments (PAG) regional model. The PAG model is based on the adopted *2030 Regional Transportation Plan* (PAG, 2006), which considers conditions resulting from all future roadway projects included in the plan.

Table A-2. 2030 forecast peak-hour traffic volumes

Location	Northbound vehicles	Southbound vehicles
Between River Road and Orange Grove Road	1,908	1,908
Between Orange Grove Road and Ina Road	1,751	1,751

Source: Kimley-Horn and Associates, Inc, *Final Traffic Engineering Study for La Cañada Drive, River Road to Ina Road*, August 2007

The vehicle mix was measured on February 14, 2007, between 8 and 9 a.m.

Table A-3. Vehicle mix

	Vehicle class percentage		
Location	**Automobiles**	**Medium trucks**	**Heavy trucks**
Between River Road and Orange Grove Road	96	2	2
Between Orange Grove Road and Ina Road	96	2	2

Source: Kimley-Horn and Associates, Inc, *Final Traffic Engineering Study for La Cañada Drive, River Road to Ina Road*, August 2007

The existing and future operating speed on La Cañada Drive is 45 mph.

Appendix B

Monitoring Sites, Receiver Locations, and Potential Barrier Locations

Appendix C

Noise Analysis Summary

APPENDIX C – NOISE ANALYSIS SUMMARY

RECEIVER ID	DISTANCE AND DIRECTION FROM FUTURE CENTERLINE (FEET)	PROPERTY ADDRESS	EXISTING CONDITION (2007) (dBA-L_{Aeq1h})	UNMITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATION CONSIDERATIONS (FOR FUTURE BUILD CONDITION)
1A	145 East	5089 N. Sunriver Circle	63	67	62	Potential Barrier 1 (See Appendix D)
1B	145 East	5085 N. Sunriver Circle	63	67	62	Potential Barrier 1 (See Appendix D)
2	250 West	5101 N. La Cañada Drive	59	62	—	None – Below PC NAP
3	160 East	5073–5077 N. Sunriver Circle	62	65	—	None – Below PC NAP
4	180 East	5069 N. Sunriver Circle 1351 W. Yaqui Drive	61	65	—	None – Below PC NAP
5	130 West	5131 N. La Cañada Drive	65	68	64	Potential Barrier 2 (See Appendix D)
6	140 East	1380 W. Kimberly Street 5057–5061 N. Sunriver Circle	63	66	61	Potential Barrier 3 (See Appendix D)
7	125 West	5171 N. La Cañada Drive	57	59	—	None – Below PC NAP
8	90 East	1350 W. Roller Coaster Road	62	66	61	Potential Barrier 4 (See Appendix D)
9	250 West	1420 W. Roller Coaster Road	58	61	—	None – Below PC NAP
10	110 West	1401 W. Neosho Place	65	69	65	Potential Barrier 5 (See Appendix D)
11	100 East	5210 N. La Cañada Drive	65	68	66	Potential Barrier 6 (See Appendix D)
12	110 East	5220 N. La Cañada Drive	64	67	62	Potential Barrier 6 (See Appendix D)
13A	110 West	1402 W. Neosho Place	65	70	65	Potential Barrier 7 (See Appendix D)
13B	100 West	5301 N. Flint Avenue	65	71	65	Potential Barrier 7 (See Appendix D)
14	115 East	5230 N. La Cañada Drive	63	68	63	Potential Barrier 6 (See Appendix D)
15	105 East	5302 N. La Cañada Drive	64	69	63	Potential Barrier 6 (See Appendix D)
16	105 East	5312 N. La Cañada Drive	64	68	63	Potential Barrier 6 (See Appendix D)

APPENDIX C – NOISE ANALYSIS SUMMARY

RECEIVER ID	DISTANCE AND DIRECTION FROM FUTURE CENTERLINE (FEET)	PROPERTY ADDRESS	EXISTING CONDITION (2007) (dBA-L_{Aeq1h})	UNMITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATION CONSIDERATIONS (FOR FUTURE BUILD CONDITION)
17A	100 West	5302 N. Flint Avenue	64	69	64	Potential Barrier 8 (See Appendix D)
17B	105 West	5335 N. La Cañada Drive *Note: Property is a take for future right-of-way*	64	70	--	None – Property is a take for the future right-of-way.
18	120 East	1341 W. Whispering Hills Drive	63	67	66	Potential Barrier 6 (See Appendix D)
19	125 East	1340 W. Whispering Hills Drive	62	67	62	Potential Barrier 9 (See Appendix D)
20	85 West	5365 N. La Cañada Drive *Note: Property is a take for future right-of-way*	65	71	--	None – Property is a take for the future right-of-way.
21	140 East	1373–1381 W. Hopbush Way	59	61	—	None – Below PC NAP
22	105 West	5405 N. La Cañada Drive	63	70	63	Potential Barrier 10 (See Appendix D)
23	160 East	1361–1369 W. Hopbush Way	60	63	—	None – Below PC NAP
24	195 West	5425 N. La Cañada Drive	59	63	—	None – Below PC NAP
25	110 East	1352 AND 1356 W. Hopbush Way	64	69	64	Potential Barrier 11 (See Appendix D)
26	125 West	5445 N. La Cañada Drive	62	69	67	Potential Barrier 10 (See Appendix D)
27	135 East	1342 W. Hopbush Way	62	65	--	None – Below PC NAP
28A	140 East	1338 W. Hopbush Way	62	66	61	Potential Barrier 12 (See Appendix D)
28B	140 East	1334 W. Hopbush Way	62	66	61	Potential Barrier 12 (See Appendix D)
29	110 West	5505 N. La Cañada Drive	63	67	65	Potential Barrier 10 (See Appendix D)
30	105 West	5555 N. La Cañada Drive	63	69	64	Potential Barrier 10 (See Appendix D)
31	235 West	1401 W. Sunset Road	58	62	—	None – Below PC NAP
32	105 West	1400 W. Sunset Road	63	70	65	Potential Barrier 13 (See Appendix D)

APPENDIX C – NOISE ANALYSIS SUMMARY

RECEIVER ID	DISTANCE AND DIRECTION FROM FUTURE CENTERLINE (FEET)	PROPERTY ADDRESS	EXISTING CONDITION (2007) (dBA-L_{Aeq1h})	UNMITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATION CONSIDERATIONS (FOR FUTURE BUILD CONDITION)
33	190 West	1411 W. Vista Alesha	60	63	—	None – Below PC NAP
34	250 East	5600 N. La Cañada Drive La Cima Middle School	58	61	—	None – Below PC NAP
35	220 West	1410 W. Vista Alesha	59	62	—	None – Below PC NAP
36	110 West	1401 W. Las Lomitas Road	63	70	66	Potential Barrier 14 (See Appendix D)
37	280 West	1441 W. Placita Las Palmas	57	60	—	None – Below PC NAP
38	110 West	1411 W. Placita Las Palmas	64	70	65	Potential Barrier 15 (See Appendix D)
39	205 West	1402 W. Placita Las Palmas	60	63	—	None – Below PC NAP
40	110 West	1415 W. Placita Pingo	65	69	64	Potential Barrier 16 (See Appendix D)
41	240 East	5950 N. La Cañada Drive California Yearly Meeting of Friends Church	57	61	—	None – Below PC NAP
42	155 West	1400 W. Placita Pingo	62	67	63	Potential Barrier 17 (See Appendix D)
43	100 West	6001 N. La Cañada Drive	65	70	65	Potential Barrier 18 (See Appendix D)
44	125 East	6055 N. Panorama Ridge Place	61	65	—	None – Below PC NAP
45	160 West	6021 N. La Cañada Drive	61	65	—	None – Below PC NAP
46	275 East	6077 N. Panorama Ridge Place	56	59	—	None – Below PC NAP
47	230 East	6099 N. Panorama Ridge Place	58	60	—	None – Below PC NAP
48	135 West	1401 W. Calle Kino	63	68	63	Potential Barrier 18 (See Appendix D)
49	250 East	1310 W. Panorama Road	57	60	—	None – Below PC NAP

APPENDIX C – NOISE ANALYSIS SUMMARY

RECEIVER ID	DISTANCE AND DIRECTION FROM FUTURE CENTERLINE (FEET)	PROPERTY ADDRESS	EXISTING CONDITION (2007) (dBA-L_{Aeq1h})	UNMITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATION CONSIDERATIONS (FOR FUTURE BUILD CONDITION)
50	105 West	1400 W. Calle Kino	64	69	64	Potential Barrier 19 (See Appendix D)
51	220 East	6100 N. La Cañada Drive	58	61	—	None – Below PC NAP
52	165 West	1401 W. Calle Tiburon	61	65	—	None – Below PC NAP
53	205 East	6140 N. La Cañada Drive	58	62	—	None – Below PC NAP
54	195 East	6160 N. La Cañada Drive	57	60	—	None – Below PC NAP
55	125 West	1400 W. Calle Tiburon	62	69	65	Potential Barrier 20 (See Appendix D)
56	180 East	1341 W. Via Caballo	59	63	—	None – Below PC NAP
57	115 East	1342 W. Via Caballo	58	63	—	None – Below PC NAP
58	145 East	1341 W. Via Tierra	60	65	—	None – Below PC NAP
59	155 East	1340 W. Via Tierra	61	67	62	Potential Barrier 21 (See Appendix D)
60	150 East	1341 W. Via Hacienda	61	67	62	Potential Barrier 21 (See Appendix D)
61	120 East	1340 W. Via Hacienda	65	68	62	Potential Barrier 22 (See Appendix D)
62	375 East	1335 W. Appian Place	55	57	—	None – Below PC NAP
63	140 West	6411 N. La Cañada Drive	63	67	62	Potential Barrier 23 (See Appendix D)
64	335 West	6420 N. Placita Tranquila	55	58	—	None – Below PC NAP
65	140 West	6431 N. La Cañada Drive	61	67	64	Potential Barrier 23 (See Appendix D)
66	465 East	1320 W. Appian Place	53	56	—	None – Below PC NAP
67	200 East	1355 W. San Lucas Drive	60	62	—	None – Below PC NAP

APPENDIX C – NOISE ANALYSIS SUMMARY

RECEIVER ID	DISTANCE AND DIRECTION FROM FUTURE CENTERLINE (FEET)	PROPERTY ADDRESS	EXISTING CONDITION (2007) (dBA-L_{Aeq1h})	UNMITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATION CONSIDERATIONS (FOR FUTURE BUILD CONDITION)
68	175 West	1401 W. San Lucas Drive	60	65	—	None – Below PC NAP
69	130 West	1402 W. San Lucas Drive	63	68	63	Potential Barrier 24 (See Appendix D)
70	205 East	1350 W. San Lucas Drive	59	62	—	None – Below PC NAP
71	140 West	6545 N. La Cañada Drive	62	67	62	Potential Barrier 24 (See Appendix D)
72	115 East	1381 W. San Nicholas Drive	64	68	63	Potential Barrier 25 (See Appendix D)
73A	135 West	1401 W. Montebella Drive	64	68	63	Potential Barrier 24 (See Appendix D)
73B	300 West	1427 W. Montebella Drive	56	59	—	None – Below PC NAP
74	190 East	1374 W. San Nicholas Drive	60	63	—	None – Below PC NAP
75	265 East	1362 W. San Nicholas Drive	57	63	—	None – Below PC NAP
76	110 West	1414 W. Montebella Drive	65	69	61	Potential Barrier 26 (See Appendix D)
77	115 East	6622 N. La Cañada Drive	64	69	64	Potential Barrier 27 (See Appendix D)
78	260 West	1440 W. Montebella Drive	57	60	—	None – Below PC NAP
79A	125 West	6645 N. La Cañada Drive	63	68	65	Potential Barrier 26 (See Appendix D)
79B	350 West	1440 W. Montebella Drive	55	58	—	None – Below PC NAP
80	270 East	1342 W. Placita Quintero	56	60	—	None – Below PC NAP
81	125 East	6642 N. La Cañada Drive	62	69	65	Potential Barrier 27 (See Appendix D)
82	95 East	6710 N. La Cañada Drive	64	69	67	Potential Barrier 27 (See Appendix D)

APPENDIX C – NOISE ANALYSIS SUMMARY

RECEIVER ID	DISTANCE AND DIRECTION FROM FUTURE CENTERLINE (FEET)	PROPERTY ADDRESS	EXISTING CONDITION (2007) (dBA-L_{Aeq1h})	UNMITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATION CONSIDERATIONS (FOR FUTURE BUILD CONDITION)
84*	370 West	6745 N. La Cañada Drive	53	58	—	None – Below PC NAP
85	190 East	6760 N. La Cañada Drive	59	62	—	None – Below PC NAP
86	185 East	6770 N. La Cañada Drive	60	64	—	None – Below PC NAP
87	330 West	1455 W. La Cañada Drive	55	58	—	None – Below PC NAP
88	135 West	1425 W. La Cañada Drive	63	66	62	Potential Barrier 28 (See Appendix D)
89	135 East	6800 N. La Cañada Drive	62	67	62	Potential Barrier 29 (See Appendix D)
90	135 East	6840 N. La Cañada Drive	62	66	61	Potential Barrier 29 (See Appendix D)
91	155 West	1411 W. Tarantula Ranch Place	61	65	—	None – Below PC NAP
92	140 East	6860 N. La Cañada Drive	62	67	62	Potential Barrier 29 (See Appendix D)
93	180 West	1412 W. Tarantula Ranch Place	58	64	—	None – Below PC NAP
94	135 East	6900 N. La Cañada Drive	61	67	64	Potential Barrier 29 (See Appendix D)
95	350 West	1460 W. Desert Harbor Circle	54	58	—	None – Below PC NAP
96	155 West	6901 N. La Cañada Drive	63	68	64	Potential Barrier 30 (See Appendix D)
97	170 East	1350 W. Chula Vista Road	59	63	—	None – Below PC NAP
98	195 East	6980 N. La Cañada Drive	58	62	—	None – Below PC NAP
99	99 East	1331 W. Giaconda Way	64	70	65	Potential Barrier 31 (See Appendix D)
100	110 West	1415 W. Giaconda Place	63	68	63	Potential Barrier 32 (See Appendix D)
101	120 East	1330 W. Giaconda Way	62	67	62	Potential Barrier 33 (See Appendix D)

APPENDIX C – NOISE ANALYSIS SUMMARY

RECEIVER ID	DISTANCE AND DIRECTION FROM FUTURE CENTERLINE (FEET)	PROPERTY ADDRESS	EXISTING CONDITION (2007) (dBA-L_{Aeq1h})	UNMITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATED FUTURE CONDITION (2030) (dBA-L_{Aeq1h})	MITIGATION CONSIDERATIONS (FOR FUTURE BUILD CONDITION)
102	115 West	1408 W. Giaconda Place	60	63	—	None – Below PC NAP
103	190 West	1431 W. Maximillian Place	58	61	—	None – Below PC NAP
104	130 East	7070 N. La Cañada Drive	62	68	63	Potential Barrier 33 (See Appendix D)
105	100 West	1415 W. Maximillian Place	63	66	62	Potential Barrier 34 (See Appendix D)
106	115 East	1330 W. Maximillian Way	65	69	66	Potential Barrier 35 (See Appendix D)
107	120 West	1408 W. Maximillian Place	64	68	63	Potential Barrier 36 (See Appendix D)
108	320 West	1443 W. Ina Road *Noise analysis for this property included in La Cañada Drive, Ina Road to Calle Concordia, Noise Report*	—	—	—	—
109	170 West	1431 W. Ina Road *Noise analysis for this property included in La Cañada Drive, Ina Road to Calle Concordia, Noise Report*	—	—	—	—

Note: Gray shading indicates the noise level exceeds the Pima County Noise Abatement Procedure criterion for noise abatement.
* Break in numbering. Number 83 was not assigned to a receiver.

Appendix D

Noise Mitigation Evaluation

APPENDIX D – NOISE MITIGATION EVALUATION

Receiver ID	Number of Units	2030 Unmitigated Noise Level (L_{Aeq1h})	2030 Mitigated Noise Level (L_{Aeq1h})	Number of Benefited Units	Potential Barrier Dimensions			Potential Barrier Costs	Comments
					Potential Barrier ID and Length	*Height**	*Potential Barrier Square Footage (SF)*	*Total Cost at $25/SF and Cost Per Benefited Receiver*	
1A 1B	6	67 67	62 62	6	Potential Barrier 1 Approximately 446 feet	8 feet	3,569	$89,237 $14,873	Potential Barrier 1 Meets PCDOT Policy
5	1	68	64**	0	Potential Barrier 2 Approximately 167 feet	10 feet	1,675	$41, 868 —	Does not meet noise reduction goal
6	2	66	61	2	Potential Barrier 3 Approximately 306 feet	6–10 feet	2,651	$66,273 $33,137	Potential Barrier 3 Meets PCDOT Policy
8	1	66	61	1	Potential Barrier 4 Approximately 154 feet	9 feet	1,387	$34,663 $34,663	Does not meet minimum number of benefited receivers
10	1	69	65**	0	Potential Barrier 5 Approximately 110 feet	10 feet	1,095	$27,378 —	Does not meet noise reduction goal
11 12 14 15 16 18	6	68 67 68 69 68 67	66** 62 63 63 63 66**	4	Potential Barrier 6 Approximately 614 feet	6–10 feet	5,585	$139,614 $34,904	Potential Barrier 6 Meets PCDOT Policy
13A 13B	2	70 71	65 65	2	Potential Barrier 7 Approximately 248 feet	7–9 feet	1,939	$48,477 $24,239	Potential Barrier 7 Meets PC DOT Policy
17A	1	69	64	1	Potential Barrier 8 Approximately 106 feet	8 feet	847	$21,182 $21,182	Does not meet minimum number of benefited receivers
19	1	67	62	1	Potential Barrier 9 Approximately 221 feet	8–10 feet	2,184	$54,604 $54,604	Exceeds maximum cost per benefited receiver
22 26 29 30	4	70 69 67 69	63 67** 65** 64	2	Potential Barrier 10 Approximately 726 feet	6–10 feet	4,600	$115,005 $57,503	Exceeds maximum cost per benefited receiver
25	2	69	64	2	Potential Barrier 11 Approximately 126 feet	6–8 feet	934	$23,352 $11,676	Potential Barrier 11 Meets PCDOT Policy

APPENDIX D – NOISE MITIGATION EVALUATION

Receiver ID	Number of Units	2030 Unmitigated Noise Level (L_{Aeq1h})	2030 Mitigated Noise Level (L_{Aeq1h})	Number of Benefited Units	Potential Barrier Dimensions			Potential Barrier Costs	Comments
					Potential Barrier ID and Length	*Height**	*Potential Barrier Square Footage (SF)*	*Total Cost at $25/SF and Cost Per Benefited Receiver*	
28A 28B	2	66 66	61 61	2	Potential Barrier 12 Approximately 248 feet	10 feet	2,477	$61,935 $30968	Potential Barrier 12 Meets PCDOT Policy
32	1	70	65	1	Potential Barrier 13 Approximately 201 feet	8–9 feet	1,675	$41,875 $41,875	Exceeds maximum cost per benefited receivers
36	1	70	66**	0	Potential Barrier 14 Approximately 192 feet	10 feet	1,922	$48,040 —	Does not meet noise reduction goal
38	1	70	65	1	Potential Barrier 15 Approximately 170 feet	8–10 feet	1,531	$38,284 $38,284	Exceeds maximum cost per benefited receiver
40	1	69	64	1	Potential Barrier 16 Approximately 136 feet	8 feet	1,089	$27,235 $27,235	Does not meet minimum number of benefited receivers
42	1	67	63**	0	Potential Barrier 17 Approximately 229 feet	10 feet	2,292	$57,312 —	Does not meet noise reduction goal
43 48	2	70 68	65 63	2	Potential Barriers 18 Approximately 505 feet	6–10 feet	4,161	$104,046 $52,023	Exceeds maximum cost per benefited receiver
50	1	69	64	1	Potential Barrier 19 Approximately 140 feet	7–10 feet	1,170	$29,262 $29,262	Does not meet minimum number of benefited receivers
55	1	69	65**	0	Potential Barrier 20 Approximately 110 feet	10 feet	1,098	$27,451 —	Does not meet noise reduction goal
59 60	2	67 67	62 62	2	Potential Barrier 21 Approximately 317 feet	7–10 feet	3,026	$75,660 $37,830	Exceeds maximum cost per benefited receiver
61	1	68	62	1	Potential Barrier 22 Approximately 188 feet	8–10 feet	1,758	$43,960 $43,960	Exceeds maximum cost per benefited receiver
63 65	2	67 67	62 64**	1	Potential Barrier 23 Approximately 249 feet	10 feet	2,499	$62,365 $62,365	Exceeds maximum cost per benefited receiver
69 71 73A	3	68 67 68	63 62 63	3	Potential Barrier 24 Approximately 507 feet	6–10 feet	4,211	$105,281 $35,094	Exceeds maximum cost per benefited receiver

APPENDIX D – NOISE MITIGATION EVALUATION

Receiver ID	Number of Units	2030 Unmitigated Noise Level (L_{Aeq1h})	2030 Mitigated Noise Level (L_{Aeq1h})	Number of Benefited Units	Potential Barrier Dimensions			Potential Barrier Costs	Comments
					Potential Barrier ID and Length	*Height**	*Potential Barrier Square Footage (SF)*	*Total Cost at $25/SF and Cost Per Benefited Receiver*	
72	1	68	63	1	Potential Barrier 25 Approximately 206 feet	8 feet	1651	$41,273 $41,273	Exceeds maximum cost per benefited receiver
76 79A	2	69 68	61 65**	1	Potential Barrier 26 Approximately 310 feet	10 feet	3,104	$77,596 $77,596	Exceeds maximum cost per benefited receiver
77 81 82	3	69 69 69	64 65** 67**	1	Potential Barrier 27 Approximately 634 feet	10 feet	6,344	$158,577 $158,577	Exceeds maximum cost per benefited receiver
88	1	66	62**	0	Potential Barrier 28 Approximately 188 feet	10 feet	1,882	$47,051 —	Exceeds maximum cost per benefited receiver
89 90 92 94	4	67 66 67 67	62 61 62 64**	3	Potential Barrier 29 Approximately 819 feet	6–10 feet	7,198	$179,957 $59,986	Exceeds maximum cost per benefited receiver
96	1	68	64**	0	Potential Barrier 30 Approximately 169 feet	10 feet	1,685	$42,128 —	Does not meet noise reduction goal
99	1	70	65	1	Potential Barrier 31 Approximately 182 feet	8–10 feet	1,660	$41,495 $41,495	Exceeds maximum cost per benefited receiver
100	1	68	63	1	Potential Barrier 32 Approximately 114 feet	8 feet	908	$22,706 $22,706	Does not meet minimum number of benefited receivers
101 104	2	67 68	62 63	2	Potential Barrier 33 Approximately 420 feet	6–9 feet	3,142	$78,550 $39,275	Exceeds maximum cost per benefited receiver
105	1	66	62**	0	Potential Barrier 34 Approximately 230 feet	10 feet	2,297	$57,432 —	Does not meet noise reduction goal
106	1	69	66**	0	Potential Barrier 35 Approximately 111 feet	10 feet	1,114	$27,848 —	Exceeds maximum cost per benefited receivers
107	1	68	63	1	Potential Barrier 36 Approximately 169 feet	8 feet	1,351	$33,771 $33,771	Exceeds maximum cost per benefited receivers

Note: Gray shading indicates the barrier meets PCDOT criteria.
* Potential barrier heights are measured from the ground surface and do not include sub-grades, footings, etc.
** Mitigation could not achieve 5 dBA reduction with maximum 10-foot high barrier

Appendix E

Traffic Noise Model (TNM 2.5) Output Files

HDR Engineering
C.B.

16 June 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: La Canada South
RUN: Existing Conditions
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver 1	1	5	0.0	62.8	66	62.8	15	----	62.8	0.0	5	-5.0
Receiver 2	2	1	0.0	58.8	66	58.8	15	----	58.8	0.0	5	-5.0
Receiver 3	3	2	0.0	61.5	66	61.5	15	----	61.5	0.0	5	-5.0
Receiver 4	4	1	0.0	61.3	66	61.3	15	----	61.3	0.0	5	-5.0
Receiver 5	5	1	0.0	64.6	66	64.6	15	----	64.6	0.0	5	-5.0
Receiver 6	6	3	0.0	62.8	66	62.8	15	----	62.8	0.0	5	-5.0
Receiver 7	7	1	0.0	56.5	66	56.5	15	----	56.5	0.0	5	-5.0
Receiver 8	8	1	0.0	61.6	66	61.6	15	----	61.6	0.0	5	-5.0
Receiver 9	9	1	0.0	58.2	66	58.2	15	----	58.2	0.0	5	-5.0
Receiver 10	10	3	0.0	65.3	66	65.3	15	----	65.3	0.0	5	-5.0
Receiver 11	11	1	0.0	64.9	66	64.9	15	----	64.9	0.0	5	-5.0
Receiver 12	12	1	0.0	63.5	66	63.5	15	----	63.5	0.0	5	-5.0
Receiver 13A	13	1	0.0	65.1	66	65.1	15	----	65.1	0.0	5	-5.0
Receiver 14	14	1	0.0	63.4	66	63.4	15	----	63.4	0.0	5	-5.0
Receiver 15	15	1	0.0	64.1	66	64.1	15	----	64.1	0.0	5	-5.0
Receiver 16	16	1	0.0	63.7	66	63.7	15	----	63.7	0.0	5	-5.0
Receiver 17B	17	1	0.0	63.8	66	63.8	15	----	63.8	0.0	5	-5.0
Receiver 18	18	1	0.0	62.8	66	62.8	15	----	62.8	0.0	5	-5.0
Receiver 19	19	1	0.0	62.1	66	62.1	15	----	62.1	0.0	5	-5.0
Receiver 20	20	1	0.0	65.3	66	65.3	15	----	65.3	0.0	5	-5.0
Receiver 21	21	1	0.0	58.6	66	58.6	15	----	58.6	0.0	5	-5.0
Receiver 22	22	1	0.0	63.4	66	63.4	15	----	63.4	0.0	5	-5.0
Receiver 23	23	3	0.0	59.5	66	59.5	15	----	59.5	0.0	5	-5.0

Receiver 24	24	1	0.0	59.0	66	59.0	15	----	59.0	0.0	5	-5.0
Receiver 25	25	2	0.0	63.9	66	63.9	15	----	63.9	0.0	5	-5.0
Receiver 26	26	1	0.0	61.7	66	61.7	15	----	61.7	0.0	5	-5.0
Receiver 27	27	1	0.0	61.9	66	61.9	15	----	61.9	0.0	5	-5.0
Receiver 28	28	1	0.0	61.6	66	61.6	15	----	61.6	0.0	5	-5.0
Receiver 29	29	1	0.0	62.6	66	62.6	15	----	62.6	0.0	5	-5.0
Receiver 30	30	1	0.0	62.8	66	62.8	15	----	62.8	0.0	5	-5.0
Receiver 31	31	1	0.0	58.1	66	58.1	15	----	58.1	0.0	5	-5.0
Receiver 32	32	1	0.0	63.2	66	63.2	15	----	63.2	0.0	5	-5.0
Receiver 33	33	1	0.0	59.5	66	59.5	15	----	59.5	0.0	5	-5.0
Receiver 34	34	1	0.0	57.6	66	57.6	15	----	57.6	0.0	5	-5.0
Receiver 35	35	1	0.0	58.9	66	58.9	15	----	58.9	0.0	5	-5.0
Receiver 36	36	1	0.0	63.2	66	63.2	15	----	63.2	0.0	5	-5.0
Receiver 37	37	1	0.0	56.6	66	56.6	15	----	56.6	0.0	5	-5.0
Receiver 38	38	1	0.0	64.2	66	64.2	15	----	64.2	0.0	5	-5.0
Receiver 39	39	1	0.0	59.9	66	59.9	15	----	59.9	0.0	5	-5.0
Receiver 40	40	1	0.0	65.0	66	65.0	15	----	65.0	0.0	5	-5.0
Receiver 41	42	1	0.0	57.4	66	57.4	15	----	57.4	0.0	5	-5.0
Receiver 42	43	1	0.0	62.4	66	62.4	15	----	62.4	0.0	5	-5.0
Receiver 43	44	1	0.0	64.9	66	64.9	15	----	64.9	0.0	5	-5.0
Receiver 44	45	1	0.0	60.6	66	60.6	15	----	60.6	0.0	5	-5.0
Receiver 45	46	1	0.0	61.0	66	61.0	15	----	61.0	0.0	5	-5.0
Receiver 46	47	1	0.0	56.0	66	56.0	15	----	56.0	0.0	5	-5.0
Receiver 47	48	1	0.0	57.5	66	57.5	15	----	57.5	0.0	5	-5.0
Receiver 48	49	1	0.0	63.2	66	63.2	15	----	63.2	0.0	5	-5.0
Receiver 49	50	1	0.0	57.2	66	57.2	15	----	57.2	0.0	5	-5.0
Receiver 50	51	1	0.0	64.2	66	64.2	15	----	64.2	0.0	5	-5.0
Receiver 51	52	1	0.0	58.1	66	58.1	15	----	58.1	0.0	5	-5.0
Receiver 52	53	1	0.0	60.6	66	60.6	15	----	60.6	0.0	5	-5.0
Receiver 53	54	1	0.0	58.4	66	58.4	15	----	58.4	0.0	5	-5.0
Receiver 54	55	1	0.0	57.0	66	57.0	15	----	57.0	0.0	5	-5.0
Receiver 55	56	1	0.0	62.4	66	62.4	15	----	62.4	0.0	5	-5.0
Receiver 56	57	1	0.0	59.0	66	59.0	15	----	59.0	0.0	5	-5.0
Receiver 57	58	1	0.0	58.4	66	58.4	15	----	58.4	0.0	5	-5.0
Receiver 58	59	1	0.0	60.4	66	60.4	15	----	60.4	0.0	5	-5.0
Receiver 59	60	1	0.0	61.2	66	61.2	15	----	61.2	0.0	5	-5.0
Receiver 60	61	1	0.0	61.3	66	61.3	15	----	61.3	0.0	5	-5.0
Receiver 61	61	1	0.0	64.5	66	64.5	15	----	64.5	0.0	5	-5.0
Receiver 62	61	1	0.0	55.1	66	55.1	15	----	55.1	0.0	5	-5.0
Receiver 63	62	1	0.0	62.5	66	62.5	15	----	62.5	0.0	5	-5.0

Receiver 64	63	1	0.0	55.3	66	55.3	15	----	55.3	0.0	5	-5.0
Receiver 65	64	1	0.0	60.5	66	60.5	15	----	60.5	0.0	5	-5.0
Receiver 66	65	1	0.0	52.9	66	52.9	15	----	52.9	0.0	5	-5.0
Receiver 67	66	1	0.0	59.5	66	59.5	15	----	59.5	0.0	5	-5.0
Receiver 68	67	1	0.0	60.4	66	60.4	15	----	60.4	0.0	5	-5.0
Receiver 69	68	1	0.0	62.6	66	62.6	15	----	62.6	0.0	5	-5.0
Receiver 70	69	1	0.0	58.9	66	58.9	15	----	58.9	0.0	5	-5.0
Receiver 71	70	1	0.0	62.1	66	62.1	15	----	62.1	0.0	5	-5.0
Receiver 72	71	1	0.0	63.8	66	63.8	15	----	63.8	0.0	5	-5.0
Receiver 73A	72	1	0.0	63.5	66	63.5	15	----	63.5	0.0	5	-5.0
Receiver 74	73	1	0.0	59.7	66	59.7	15	----	59.7	0.0	5	-5.0
Receiver 75	74	1	0.0	56.6	66	56.6	15	----	56.6	0.0	5	-5.0
Receiver 76	75	1	0.0	64.5	66	64.5	15	----	64.5	0.0	5	-5.0
Receiver 77	76	1	0.0	64.0	66	64.0	15	----	64.0	0.0	5	-5.0
Receiver 78	77	1	0.0	56.9	66	56.9	15	----	56.9	0.0	5	-5.0
Receiver 79A	78	1	0.0	63.3	66	63.3	15	----	63.3	0.0	5	-5.0
Receiver 80	79	1	0.0	55.8	66	55.8	15	----	55.8	0.0	5	-5.0
Receiver 81	80	1	0.0	62.4	66	62.4	15	----	62.4	0.0	5	-5.0
Receiver 82	81	1	0.0	63.6	66	63.6	15	----	63.6	0.0	5	-5.0
Receiver 84	83	1	0.0	53.4	66	53.4	15	----	53.4	0.0	5	-5.0
Receiver 85	84	1	0.0	58.5	66	58.5	15	----	58.5	0.0	5	-5.0
Receiver 86	85	1	0.0	60.1	66	60.1	15	----	60.1	0.0	5	-5.0
Receiver 87	86	1	0.0	54.7	66	54.7	15	----	54.7	0.0	5	-5.0
Receiver 88	87	1	0.0	63.4	66	63.4	15	----	63.4	0.0	5	-5.0
Receiver 89	88	1	0.0	62.0	66	62.0	15	----	62.0	0.0	5	-5.0
Receiver 90	89	1	0.0	62.4	66	62.4	15	----	62.4	0.0	5	-5.0
Receiver 91	90	1	0.0	61.3	66	61.3	15	----	61.3	0.0	5	-5.0
Receiver 92	91	1	0.0	62.0	66	62.0	15	----	62.0	0.0	5	-5.0
Receiver 93	92	1	0.0	57.5	66	57.5	15	----	57.5	0.0	5	-5.0
Receiver 94	93	1	0.0	61.4	66	61.4	15	----	61.4	0.0	5	-5.0
Receiver 95	94	1	0.0	53.8	66	53.8	15	----	53.8	0.0	5	-5.0
Receiver 96	95	1	0.0	62.9	66	62.9	15	----	62.9	0.0	5	-5.0
Receiver 97	96	1	0.0	58.8	66	58.8	15	----	58.8	0.0	5	-5.0
Receiver 98	97	1	0.0	58.0	66	58.0	15	----	58.0	0.0	5	-5.0
Receiver 99	98	1	0.0	63.8	66	63.8	15	----	63.8	0.0	5	-5.0
Receiver 100	99	1	0.0	63.1	66	63.1	15	----	63.1	0.0	5	-5.0
Receiver 101	100	1	0.0	62.4	66	62.4	15	----	62.4	0.0	5	-5.0
Receiver 102	101	1	0.0	59.7	66	59.7	15	----	59.7	0.0	5	-5.0
Receiver 103	103	1	0.0	57.5	66	57.5	15	----	57.5	0.0	5	-5.0
Receiver 104	104	1	0.0	62.4	66	62.4	15	----	62.4	0.0	5	-5.0

RESULTS: SOUND LEVELS

La Canada South

Receiver 105	105	1	0.0	62.7	66	62.7	15	----	62.7	0.0	5	-5.0
Receiver 106	106	1	0.0	64.8	66	64.8	15	----	64.8	0.0	5	-5.0
Receiver 107	109	1	0.0	64.2	66	64.2	15	----	64.2	0.0	5	-5.0
Receiver 108	110	1	0.0	54.6	66	54.6	15	----	54.6	0.0	5	-5.0
Receiver 109	117	1	0.0	60.3	66	60.3	15	----	60.3	0.0	5	-5.0
Receiver 13B	118	1	0.0	64.9	66	64.9	15	----	64.9	0.0	5	-5.0
Receiver 17A	119	1	0.0	63.7	66	63.7	15	----	63.7	0.0	5	-5.0
Receiver 73B	121	1	0.0	55.5	66	55.5	15	----	55.5	0.0	5	-5.0
Receiver 79B	122	1	0.0	54.6	66	54.6	15	----	54.6	0.0	5	-5.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB
All Selected	124	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

HDR Engineering
C.B.

16 June 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: La Canada South
RUN: Future Conditions, PCDOT Criteria
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver 1	1	5	0.0	66.1	66	66.1	15	Snd Lvl	66.1	0.0	5	-5.0
Receiver 2	2	1	0.0	62.1	66	62.1	15	---	62.1	0.0	5	-5.0
Receiver 3	3	2	0.0	64.9	66	64.9	15	---	64.9	0.0	5	-5.0
Receiver 4	4	1	0.0	64.7	66	64.7	15	---	64.7	0.0	5	-5.0
Receiver 5	5	1	0.0	67.9	66	67.9	15	Snd Lvl	67.9	0.0	5	-5.0
Receiver 6	6	3	0.0	66.1	66	66.1	15	Snd Lvl	66.1	0.0	5	-5.0
Receiver 7	7	1	0.0	59.9	66	59.9	15	---	59.9	0.0	5	-5.0
Receiver 8	8	1	0.0	65.3	66	65.3	15	---	65.3	0.0	5	-5.0
Receiver 9	9	1	0.0	61.8	66	61.8	15	---	61.8	0.0	5	-5.0
Receiver 10	10	3	0.0	69.1	66	69.1	15	Snd Lvl	69.1	0.0	5	-5.0
Receiver 11	11	1	0.0	68.6	66	68.6	15	Snd Lvl	68.6	0.0	5	-5.0
Receiver 12	12	1	0.0	67.5	66	67.5	15	Snd Lvl	67.5	0.0	5	-5.0
Receiver 13A	13	1	0.0	69.8	66	69.8	15	Snd Lvl	69.8	0.0	5	-5.0
Receiver 14	14	1	0.0	68.4	66	68.4	15	Snd Lvl	68.4	0.0	5	-5.0
Receiver 15	15	1	0.0	69.3	66	69.3	15	Snd Lvl	69.3	0.0	5	-5.0
Receiver 16	16	1	0.0	68.6	66	68.6	15	Snd Lvl	68.6	0.0	5	-5.0
Receiver 17B	17	1	0.0	69.8	66	69.8	15	Snd Lvl	69.8	0.0	5	-5.0
Receiver 18	18	1	0.0	67.5	66	67.5	15	Snd Lvl	67.5	0.0	5	-5.0
Receiver 19	19	1	0.0	67.1	66	67.1	15	Snd Lvl	67.1	0.0	5	-5.0
Receiver 20	20	1	0.0	70.0	66	70.0	15	Snd Lvl	70.0	0.0	5	-5.0
Receiver 21	21	1	0.0	62.8	66	62.8	15	---	62.8	0.0	5	-5.0
Receiver 22	22	1	0.0	69.5	66	69.5	15	Snd Lvl	69.5	0.0	5	-5.0
Receiver 23	23	3	0.0	64.0	66	64.0	15	---	64.0	0.0	5	-5.0

Receiver 24	24	1	0.0	64.4	66	64.4	15	----	64.4	0.0	5	-5.0
Receiver 25	25	2	0.0	69.9	66	69.9	15	Snd Lvl	69.9	0.0	5	-5.0
Receiver 26	26	1	0.0	67.8	66	67.8	15	Snd Lvl	67.8	0.0	5	-5.0
Receiver 27	27	1	0.0	67.9	66	67.9	15	Snd Lvl	67.9	0.0	5	-5.0
Receiver 28	28	1	0.0	67.5	66	67.5	15	Snd Lvl	67.5	0.0	5	-5.0
Receiver 29	29	1	0.0	66.9	66	66.9	15	Snd Lvl	66.9	0.0	5	-5.0
Receiver 30	30	1	0.0	68.7	66	68.7	15	Snd Lvl	68.7	0.0	5	-5.0
Receiver 31	31	1	0.0	62.5	66	62.5	15	----	62.5	0.0	5	-5.0
Receiver 32	32	1	0.0	69.4	66	69.4	15	Snd Lvl	69.4	0.0	5	-5.0
Receiver 33	33	1	0.0	64.0	66	64.0	15	----	64.0	0.0	5	-5.0
Receiver 34	34	1	0.0	61.1	66	61.1	15	----	61.1	0.0	5	-5.0
Receiver 35	35	1	0.0	62.5	66	62.5	15	----	62.5	0.0	5	-5.0
Receiver 36	36	1	0.0	69.0	66	69.0	15	Snd Lvl	69.0	0.0	5	-5.0
Receiver 37	37	1	0.0	60.3	66	60.3	15	----	60.3	0.0	5	-5.0
Receiver 38	38	1	0.0	69.3	66	69.3	15	Snd Lvl	69.3	0.0	5	-5.0
Receiver 39	39	1	0.0	63.3	66	63.3	15	----	63.3	0.0	5	-5.0
Receiver 40	40	1	0.0	69.4	66	69.4	15	Snd Lvl	69.4	0.0	5	-5.0
Receiver 41	42	1	0.0	60.7	66	60.7	15	----	60.7	0.0	5	-5.0
Receiver 42	43	1	0.0	65.8	66	65.8	15	----	65.8	0.0	5	-5.0
Receiver 43	44	1	0.0	69.6	66	69.6	15	Snd Lvl	69.6	0.0	5	-5.0
Receiver 44	45	1	0.0	64.9	66	64.9	15	----	64.9	0.0	5	-5.0
Receiver 45	46	1	0.0	64.9	66	64.9	15	----	64.9	0.0	5	-5.0
Receiver 46	47	1	0.0	59.3	66	59.3	15	----	59.3	0.0	5	-5.0
Receiver 47	48	1	0.0	60.9	66	60.9	15	----	60.9	0.0	5	-5.0
Receiver 48	49	1	0.0	67.0	66	67.0	15	Snd Lvl	67.0	0.0	5	-5.0
Receiver 49	50	1	0.0	60.6	66	60.6	15	----	60.6	0.0	5	-5.0
Receiver 50	51	1	0.0	68.9	66	68.9	15	Snd Lvl	68.9	0.0	5	-5.0
Receiver 51	52	1	0.0	61.7	66	61.7	15	----	61.7	0.0	5	-5.0
Receiver 52	53	1	0.0	65.1	66	65.1	15	----	65.1	0.0	5	-5.0
Receiver 53	54	1	0.0	62.9	66	62.9	15	----	62.9	0.0	5	-5.0
Receiver 54	55	1	0.0	61.5	66	61.5	15	----	61.5	0.0	5	-5.0
Receiver 55	56	1	0.0	68.3	66	68.3	15	Snd Lvl	68.3	0.0	5	-5.0
Receiver 56	57	1	0.0	64.5	66	64.5	15	----	64.5	0.0	5	-5.0
Receiver 57	58	1	0.0	63.6	66	63.6	15	----	63.6	0.0	5	-5.0
Receiver 58	59	1	0.0	65.6	66	65.6	15	----	65.6	0.0	5	-5.0
Receiver 59	60	1	0.0	65.9	66	65.9	15	----	65.9	0.0	5	-5.0
Receiver 60	61	1	0.0	65.6	66	65.6	15	----	65.6	0.0	5	-5.0
Receiver 61	61	1	0.0	67.8	66	67.8	15	Snd Lvl	67.8	0.0	5	-5.0
Receiver 62	61	1	0.0	58.3	66	58.3	15	----	58.3	0.0	5	-5.0
Receiver 63	62	1	0.0	65.5	66	65.5	15	----	65.5	0.0	5	-5.0

Receiver 64	63	1	0.0	58.7	66	58.7	15	----	58.7	0.0	5	-5.0
Receiver 65	64	1	0.0	65.2	66	65.2	15	----	65.2	0.0	5	-5.0
Receiver 66	65	1	0.0	56.0	66	56.0	15	----	56.0	0.0	5	-5.0
Receiver 67	66	1	0.0	63.1	66	63.1	15	----	63.1	0.0	5	-5.0
Receiver 68	67	1	0.0	64.3	66	64.3	15	----	64.3	0.0	5	-5.0
Receiver 69	68	1	0.0	66.8	66	66.8	15	Snd Lvl	66.8	0.0	5	-5.0
Receiver 70	69	1	0.0	62.3	66	62.3	15	----	62.3	0.0	5	-5.0
Receiver 71	70	1	0.0	65.5	66	65.5	15	----	65.5	0.0	5	-5.0
Receiver 72	71	1	0.0	67.6	66	67.6	15	Snd Lvl	67.6	0.0	5	-5.0
Receiver 73A	72	1	0.0	66.9	66	66.9	15	Snd Lvl	66.9	0.0	5	-5.0
Receiver 74	73	1	0.0	62.6	66	62.6	15	----	62.6	0.0	5	-5.0
Receiver 75	74	1	0.0	59.5	66	59.5	15	----	59.5	0.0	5	-5.0
Receiver 76	75	1	0.0	68.6	66	68.6	15	Snd Lvl	68.6	0.0	5	-5.0
Receiver 77	76	1	0.0	68.1	66	68.1	15	Snd Lvl	68.1	0.0	5	-5.0
Receiver 78	77	1	0.0	60.2	66	60.2	15	----	60.2	0.0	5	-5.0
Receiver 79A	78	1	0.0	68.0	66	68.0	15	Snd Lvl	68.0	0.0	5	-5.0
Receiver 80	79	1	0.0	58.8	66	58.8	15	----	58.8	0.0	5	-5.0
Receiver 81	80	1	0.0	67.3	66	67.3	15	Snd Lvl	67.3	0.0	5	-5.0
Receiver 82	81	1	0.0	68.8	66	68.8	15	Snd Lvl	68.8	0.0	5	-5.0
Receiver 84	83	1	0.0	56.7	66	56.7	15	----	56.7	0.0	5	-5.0
Receiver 85	84	1	0.0	61.8	66	61.8	15	----	61.8	0.0	5	-5.0
Receiver 86	85	1	0.0	63.3	66	63.3	15	----	63.3	0.0	5	-5.0
Receiver 87	86	1	0.0	57.8	66	57.8	15	----	57.8	0.0	5	-5.0
Receiver 88	87	1	0.0	67.6	66	67.6	15	Snd Lvl	67.6	0.0	5	-5.0
Receiver 89	88	1	0.0	65.6	66	65.6	15	----	65.6	0.0	5	-5.0
Receiver 90	89	1	0.0	65.6	66	65.6	15	----	65.6	0.0	5	-5.0
Receiver 91	90	1	0.0	64.6	66	64.6	15	----	64.6	0.0	5	-5.0
Receiver 92	91	1	0.0	65.5	66	65.5	15	----	65.5	0.0	5	-5.0
Receiver 93	92	1	0.0	61.4	66	61.4	15	----	61.4	0.0	5	-5.0
Receiver 94	93	1	0.0	65.8	66	65.8	15	----	65.8	0.0	5	-5.0
Receiver 95	94	1	0.0	57.0	66	57.0	15	----	57.0	0.0	5	-5.0
Receiver 96	95	1	0.0	67.5	66	67.5	15	Snd Lvl	67.5	0.0	5	-5.0
Receiver 97	96	1	0.0	62.5	66	62.5	15	----	62.5	0.0	5	-5.0
Receiver 98	97	1	0.0	61.6	66	61.6	15	----	61.6	0.0	5	-5.0
Receiver 99	98	1	0.0	69.0	66	69.0	15	Snd Lvl	69.0	0.0	5	-5.0
Receiver 100	99	1	0.0	68.0	66	68.0	15	Snd Lvl	68.0	0.0	5	-5.0
Receiver 101	100	1	0.0	66.8	66	66.8	15	Snd Lvl	66.8	0.0	5	-5.0
Receiver 102	101	1	0.0	63.3	66	63.3	15	----	63.3	0.0	5	-5.0
Receiver 103	103	1	0.0	61.0	66	61.0	15	----	61.0	0.0	5	-5.0
Receiver 104	104	1	0.0	67.2	66	67.2	15	Snd Lvl	67.2	0.0	5	-5.0

Receiver 105	105	1	0.0	66.1	66	66.1	15	Snd Lvl	66.1	0.0	5	-5.0
Receiver 106	106	1	0.0	68.3	66	68.3	15	Snd Lvl	68.3	0.0	5	-5.0
Receiver 107	109	1	0.0	67.6	66	67.6	15	Snd Lvl	67.6	0.0	5	-5.0
Receiver 108	110	1	0.0	57.8	66	57.8	15	----	57.8	0.0	5	-5.0
Receiver 109	117	1	0.0	63.5	66	63.5	15	----	63.5	0.0	5	-5.0
Receiver 13B	118	1	0.0	69.9	66	69.9	15	Snd Lvl	69.9	0.0	5	-5.0
Receiver 17A	119	1	0.0	68.8	66	68.8	15	Snd Lvl	68.8	0.0	5	-5.0
Receiver 73B	121	1	0.0	58.7	66	58.7	15	----	58.7	0.0	5	-5.0
Receiver 79B	122	1	0.0	58.1	66	58.1	15	----	58.1	0.0	5	-5.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB
All Selected	124	0.0	0.0	0.0
All Impacted	58	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

HDR Engineering
C.B.

16 June 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: La Canada South
RUN: Second Row Future, PCDOT Criteria
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver												
Name	No.	#DUs	Existing LAeq1h	No Barrier					With Barrier			
				LAeq1h		Increase over existing		Type	Calculated	Noise Reduction		
				Calculated	Crit'n	Calculated	Crit'n Sub'l Inc	Impact	LAeq1h	Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
5366 N. Flint Ave	125	1	72.5	61.9	66	-10.6	10	----	61.9	0.0	5	-5.0
5340 N. Flint Ave	126	1	72.5	61.7	66	-10.8	10	----	61.7	0.0	5	-5.0
5302 N. Flint Ave	127	1	72.5	62.4	66	-10.1	10	----	62.4	0.0	5	-5.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB
All Selected	3	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

HDR Engineering
C.B.

16 June 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: La Canada South
RUN: Proposed - Seg. 1 - PC Criteria No RAC
BARRIER DESIGN: INPUT HEIGHTS

ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver											
Name	#DUs	Existing LAeq1h	No Barrier					With Barrier			
			LAeq1h		Increase over existing		Type Impact	Calculated LAeq1h	Noise Reduction		
			Calculated	Crit'n	Calculated	Crit'n Sub'l Inc			Calculated	Goal	Calculated minus Goal
		dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver 1A	3	0	67.3	66	67.3	15	Snd Lvl	62	5.3	5	0.3
Receiver 1B	1	0	66.6	66	66.6	10	Snd Lvl	62	4.6	5	-0.4
Receiver 2	1	0	62	66	62	15	----	60.9	1.1	5	-3.9
Receiver 3	2	0	65.1	66	65.1	15	----	62.2	2.9	5	-2.1
Receiver 4	1	0	64.8	66	64.8	15	----	64.1	0.7	5	-4.3
Receiver 5	1	0	68	66	68	15	Snd Lvl	64.4	3.6	5	-1.4
Receiver 6	3	0	66.3	66	66.3	15	Snd Lvl	61.4	4.9	5	-0.1
Receiver 7	1	0	59.4	66	59.4	15	----	59	0.4	5	-4.6
Receiver 8	1	0	65.8	66	65.8	15	----	61.2	4.6	5	-0.4
Receiver 9	1	0	61	66	61	15	----	60.6	0.4	5	-4.6
Receiver 10	1	0	69.4	66	69.4	15	Snd Lvl	65.1	4.3	5	-0.7
Receiver 11	1	0	68.2	66	68.2	15	Snd Lvl	65.9	2.3	5	-2.7
Receiver 12	1	0	66.7	66	66.7	15	Snd Lvl	62.4	4.3	5	-0.7
Receiver 13A	1	0	70.4	66	70.4	15	Snd Lvl	64.7	5.7	5	0.7
Receiver 13B	1	0	70.6	66	70.6	15	Snd Lvl	65.2	5.4	5	0.4
Receiver 14	1	0	68	66	68	15	Snd Lvl	62.5	5.5	5	0.5
Receiver 15	1	0	69	66	69	15	Snd Lvl	62.9	6.1	5	1.1
Receiver 16	1	0	68.4	66	68.4	15	Snd Lvl	63.4	5	5	0
Receiver 17A	1	0	69.1	66	69.1	15	Snd Lvl	64.3	4.8	5	-0.2

Receiver 17B	1	0	70.1	66	70.1	15	Snd Lvl	66	4.1	5	-0.9
Receiver 18	1	0	67.4	66	67.4	15	Snd Lvl	65.9	1.5	5	-3.5
Receiver 19	1	0	67.1	66	67.1	15	Snd Lvl	62.4	4.7	5	-0.3
Receiver 20	1	0	70.5	66	70.5	15	Snd Lvl	65.3	5.2	5	0.2
Receiver 21	3	0	61	66	61	15	----	60.3	0.7	5	-4.3
Receiver 22	1	0	69.7	66	69.7	15	Snd Lvl	63.4	6.3	5	1.3
Receiver 23	3	0	62.5	66	62.5	15	----	61.6	0.9	5	-4.1
Receiver 24	1	0	62.9	66	62.9	15	----	60.9	2	5	-3
Receiver 25	2	0	68.9	66	68.9	15	Snd Lvl	64.4	4.5	5	-0.5
Receiver 26	1	0	68.6	66	68.6	15	Snd Lvl	66.7	1.9	5	-3.1
Receiver 27	1	0	65.3	66	65.3	15	----	62.4	2.9	5	-2.1
Receiver 28A	1	0	65.5	66	65.5	15	----	61.1	4.4	5	-0.6
Receiver 28B	1	0	66	66	66	10	Snd Lvl	61.4	4.6	5	-0.4
Receiver 29	1	0	67.1	66	67.1	15	Snd Lvl	65.3	1.8	5	-3.2
Receiver 30	1	0	69.4	66	69.4	15	Snd Lvl	64.4	5	5	0
Receiver 31	1	0	62.2	66	62.2	15	----	61.4	0.8	5	-4.2
Receiver 32	1	0	69.8	66	69.8	15	Snd Lvl	65.2	4.6	5	-0.4
Receiver 33	1	0	63.4	66	63.4	15	----	63.3	0.1	5	-4.9
Receiver 34	1	0	60.7	66	60.7	15	----	60.7	0	5	-5
Receiver 35	1	0	62.3	66	62.3	15	----	62.2	0.1	5	-4.9
Receiver 36	1	0	69.9	66	69.9	15	Snd Lvl	65.7	4.2	5	-0.8
Receiver 37	1	0	60.3	66	60.3	15	----	59.6	0.7	5	-4.3
Receiver 38	1	0	69.8	66	69.8	15	Snd Lvl	65.4	4.4	5	-0.6
Receiver 39	1	0	63.1	66	63.1	15	----	62.5	0.6	5	-4.4
Receiver 40	1	0	69.2	66	69.2	15	Snd Lvl	64.4	4.8	5	-0.2
Receiver 41	1	0	60.7	66	60.7	15	----	60.7	0	5	-5
Receiver 42	1	0	66.9	66	66.9	15	Snd Lvl	62.8	4.1	5	-0.9
Receiver 43	1	0	69.7	66	69.7	15	Snd Lvl	64.7	5	5	0
Receiver 44	1	0	65.1	66	65.1	15	----	65.1	0	5	-5

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	58	0	1.2	5.4
All Impacted	10	4.1	4.7	5.4
All that meet NR Goal	2	5	5.2	5.4

HDR Engineering
C.B.

16 June 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: La Canada South
RUN: Proposed - Seg 2 - PC Criteria No RAC
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	No Barrier LAeq1h Crit'n	Increase over existing Calculated	Increase over existing Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
		dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver 45	1	0	65.3	66	65.3	15	----	62.5	2.8	5	-2.2
Receiver 46	1	0	59.2	66	59.2	15	----	59.2	0	5	-5
Receiver 47	1	0	60.4	66	60.4	15	----	60.4	0	5	-5
Receiver 48	1	0	67.7	66	67.7	15	Snd Lvl	63.1	4.6	5	-0.4
Receiver 49	1	0	60.2	66	60.2	15	----	60.2	0	5	-5
Receiver 50	1	0	68.9	66	68.9	15	Snd Lvl	64.3	4.6	5	-0.4
Receiver 51	1	0	61.1	66	61.1	15	----	61.1	0	5	-5
Receiver 52	1	0	64.7	66	64.7	15	----	64.1	0.6	5	-4.4
Receiver 53	1	0	61.7	66	61.7	15	----	61.7	0	5	-5
Receiver 54	1	0	60.4	66	60.4	15	----	60.4	0	5	-5
Receiver 55	1	0	68.6	66	68.6	15	Snd Lvl	64.6	4	5	-1
Receiver 56	1	0	63	66	63	15	----	63	0	5	-5
Receiver 57	1	0	63.2	66	63.2	15	----	63.1	0.1	5	-4.9
Receiver 58	1	0	65	66	65	15	----	64.7	0.3	5	-4.7
Receiver 59	1	0	66.6	66	66.6	15	Snd Lvl	62.4	4.2	5	-0.8
Receiver 60	1	0	66.6	66	66.6	15	Snd Lvl	62.3	4.3	5	-0.7
Receiver 61	1	0	67.9	66	67.9	15	Snd Lvl	62.3	5.6	5	0.6
Receiver 62	1	0	57	66	57	15	----	56.8	0.2	5	-4.8
Receiver 63	1	0	66.7	66	66.7	15	Snd Lvl	62.2	4.5	5	-0.5
Receiver 64	1	0	57.7	66	57.7	15	----	56.9	0.8	5	-4.2

Receiver 65	1	0	66.8	66	66.8	15	Snd Lvl	63.8	3	5	-2
Receiver 66	1	0	55.9	66	55.9	15	----	55.6	0.3	5	-4.7
Receiver 67	1	0	62.4	66	62.4	15	----	62.3	0.1	5	-4.9
Receiver 68	1	0	65.2	66	65.2	15	----	64.6	0.6	5	-4.4
Receiver 69	1	0	67.9	66	67.9	15	Snd Lvl	63.4	4.5	5	-0.5
Receiver 70	1	0	62	66	62	15	----	61.6	0.4	5	-4.6
Receiver 71	1	0	66.5	66	66.5	15	Snd Lvl	62.4	4.1	5	-0.9
Receiver 72	1	0	68	66	68	15	Snd Lvl	62.9	5.1	5	0.1
Receiver 73A	1	0	67.9	66	67.9	15	Snd Lvl	63.2	4.7	5	-0.3
Receiver 73B	1	0	59.3	66	59.3	15	----	57.4	1.9	5	-3.1
Receiver 74	1	0	62.9	66	62.9	15	----	62.1	0.8	5	-4.2
Receiver 75	1	0	62.8	66	62.8	15	----	62.8	0	5	-5
Receiver 76	1	0	68.6	66	68.6	15	Snd Lvl	60.8	7.8	5	2.8
Receiver 77	1	0	69.1	66	69.1	15	Snd Lvl	64.3	4.8	5	-0.2
Receiver 78	1	0	60.3	66	60.3	15	----	57.5	2.8	5	-2.2
Receiver 79A	1	0	68	66	68	15	Snd Lvl	64.6	3.4	5	-1.6
Receiver 79B	1	0	58.4	66	58.4	15	----	57.3	1.1	5	-3.9
Receiver 80	1	0	59.6	66	59.6	15	----	57.5	2.1	5	-2.9
Receiver 81	1	0	68.5	66	68.5	15	Snd Lvl	64.6	3.9	5	-1.1
Receiver 82	1	0	69.2	66	69.2	15	Snd Lvl	66.8	2.4	5	-2.6
Receiver 84	1	0	57.7	66	57.7	15	----	57.2	0.5	5	-4.5
Receiver 85	1	0	62.3	66	62.3	15	----	59.1	3.2	5	-1.8
Receiver 86	1	0	63.9	66	63.9	15	----	60.9	3	5	-2
Receiver 87	1	0	57.7	66	57.7	15	----	57.1	0.6	5	-4.4
Receiver 88	1	0	65.7	66	65.7	15	----	62.3	3.4	5	-1.6
Receiver 89	1	0	66.6	66	66.6	15	Snd Lvl	62.2	4.4	5	-0.6
Receiver 90	1	0	66.4	66	66.4	15	Snd Lvl	60.8	5.6	5	0.6
Receiver 91	1	0	64.9	66	64.9	15	----	64.8	0.1	5	-4.9
Receiver 92	1	0	66.8	66	66.8	15	Snd Lvl	62.4	4.4	5	-0.6
Receiver 93	1	0	64.3	66	64.3	15	----	64.2	0.1	5	-4.9
Receiver 94	1	0	66.8	66	66.8	15	Snd Lvl	63.5	3.3	5	-1.7
Receiver 95	1	0	57.8	66	57.8	15	----	57.2	0.6	5	-4.4
Receiver 96	1	0	67.9	66	67.9	15	Snd Lvl	64.2	3.7	5	-1.3
Receiver 97	1	0	62.9	66	62.9	15	----	62.6	0.3	5	-4.7
Receiver 98	1	0	61.7	66	61.7	15	----	61.1	0.6	5	-4.4
Receiver 99	1	0	69.5	66	69.5	15	Snd Lvl	65.3	4.2	5	-0.8
Receiver 100	1	0	68	66	68	15	Snd Lvl	62.9	5.1	5	0.1

Receiver 101	1	0	66.7	66	66.7	15	Snd Lvl	62.4	4.3	5	-0.7
Receiver 102	1	0	63.3	66	63.3	15	----	63.1	0.2	5	-4.8
Receiver 103	1	0	61	66	61	15	----	59.5	1.5	5	-3.5
Receiver 104	1	0	68.2	66	68.2	15	Snd Lvl	63.4	4.8	5	-0.2
Receiver 105	1	0	66.3	66	66.3	15	Snd Lvl	61.8	4.5	5	-0.5
Receiver 106	1	0	68.6	66	68.6	15	Snd Lvl	66.3	2.3	5	-2.7
Receiver 107	1	0	67.7	66	67.7	15	Snd Lvl	63.1	4.6	5	-0.4
Receiver 108	1	0	57.9	66	57.9	15	----	57.4	0.5	5	-4.5
Receiver 109	1	0	63.7	66	63.7	15	----	63.5	0.2	5	-4.8

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	66	0	2.4	7.8
All Impacted	29	2.3	4.4	7.8
All that meet NR Goal	5	5.1	5.8	7.8